M. 2

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θ	ds	θ	ds	θ	ds
0°	+3".41	31	+2.22	62	+0.31
1	3.40	32	2.16	63	0.25
2	3.38	33	2.10	64	0.19
3	3.37	34	2.04	65	0.12
4	3.35	35	1.98	66	+0.06
5	3.34	36	1.92	67	0.00
6	3.32	37	1.86	68	−0.06
7	3.30	38	1.79	69	0.12
8	3.28	39	1.73	70	0.19
9	3.26	40	1.67	71	0.25
10	3.23	41	1.61	72	0.31
11	3.20	42	1.55	73	0.37
12	3.16	43	1.49	74	0.43
13	3.13	44	1.43	75	0.50
14	3.09	45	1.36	76	0.56
15	3.05	46	1.30	77	0.62
16	3.01	47	1.24	78	0.68
17	2.97	48	1.19	79	0.74
18	2.92	49	1.12	80	0.81
19	2.88	50	1.05	81	0.87
20	2.83	51	0.99	82	0.93
21	2.78	52	0.93	83	0.99
22	2.72	53	0.87	84	−1.05
23	2.67	54	0.81		
24	2.61	55	0.74		
25	2.56	56	0.68		
26	2.51	57	0.62		
27	2.46	58	0.56		
28	2.40	59	0.50		
29	2.34	60	0.43		
30	2.28	61	0.37		

New Reduction of 1853 — of all the zones from 1 to 9 shall use the following weights for the different Catalogues

	in R	in Dec
Weisse wt =	1	1
12 Year. Cat " =	4	4
Struve Pos. Micl. " =	4	4
Santini =	3	3
Taylor =	2	2
Ed obs BAC	2	2

Unit of weight in R corresponds to the probable error of p

ε = ± 0.s108	By Zone 1	9 stars
168	" 49	13 "
270	" 50	13 "

Mean ε = ± 0.s189 for R

For Dec ε = ± 1".6 Zone 1

2.25	49
1.8	50

Mean ε = ± 1".9

I shall adopt these for the new reduction the weights as above given — I shall consider the probable error of the zero of a zone for a value of p derived from a single obs of a Weisse star in R ε = ± 0.s20 in Dec ε = ± 2".0

For combination of adjacent zones.

ε_1 = prob. error of zero of standard zone

ε_2 = 0.s048 = " an observation by two wires in R

ε_2 = 0".62 " in Dec

Pr. er of a determination of zero of compared zone by n obs

$$\varepsilon = \sqrt{\varepsilon_1^2 + \frac{2}{n}\varepsilon_2^2}$$

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Reduction of Zones in Right Ascension.

Let t = the reading from the sheet.
α = the mean right ascension of the star at the beginning of the year.
R = the apparent right ascension of the star at the time of observation.
k = a correction to be added algebraically to t to produce α
p = the zero error of the sheet reading.
$d\alpha$ = the correction applied algebraically to α to produce R
dt = the correction for clock rate, positive if it gains.
h = the hourangle of instrument positive when West of meridian

$\alpha = t + k$ $\qquad R = \alpha + d\alpha$ $\qquad d\alpha = f + g\sin(G+\alpha)\tan\delta + h\sin(H+\alpha)\sec\delta.$

$k = p - (d\alpha + dt) + (d\alpha - d\alpha_1)s + dK.s$

Take T_0, T_1 and T_2 to represent even hours of right ascension including the zone.

1st Calculate $d\alpha$ for T_0, T_1 and T_2 for the declination corresponding to the zero of the scale. and the change of $d\alpha$ at T_1 for an increase of 10′ in declination. Enter these in form no. 2 with dt and form the column $d\alpha + dt$

2nd Reduce all the known stars in the zone to the mean equinox at the beginning of the year, and find for each $p = (\alpha - t) + (d\alpha + dt)$ interpolating $(d\alpha + dt)$ from the column just computed. The mean of these according to their weights will give a value of p to be entered in form No 2 & thence will be found $k = p - (d\alpha + dt)$ for T_0, T_1 and T_2 from these interpolate k for every ten minutes of right ascension.

The correction for difference of refraction in right ascension will be less than $0^s.01$ if the zone is north of $-20°$ declination and the hour angle less than one hour.

Note that the values of k are to be tested on a known star

If the hour angle be considerable k must be corrected for refraction. See Bessel's formula Astr. Nach. No. 69. If we put k_1 for the value of k for 10′ of the scale $d\alpha_1$ for the value of $d\alpha$ for 10′ of scale

$k_1 = k + (d\alpha - d\alpha_1) + 0^s.028 \tan h$ for stars near the equator & less than 3^h from meridian.

Put $d_1 k = 0^s.028 \sin h$ including error of setting position circle by refracted motion

Change of k for + 10′ of declination $= (d\alpha_0 - d\alpha_1) + 0^s.028 \tan\delta \sin h$

$= (d\alpha_0 - d\alpha_1) \pm d_1 k$ + for Western hour angles
− for Eastern "

An error of $0^s.01$ in the position circle makes an error $= 0^s.0116 \sec\delta$ in the relative Rs of two stars differing 10′ in Dec from each other.

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Reduction of Zones in Declination.

Let s = the reading of the scale for declination.
ds = the correction to produce the true value of s in arc. applied algebraically
δ = the mean declination of the star at the beginning of the year
D = the apparent declination of the star.
d = the correction to be applied algebraically to s to produce mean declinations [when $s = 0$
g = the zero error of the reading of the scale in declination
$d\delta$ = the correction applied algebraically to δ to produce D. for the zero of the scale
dr = the difference of refraction for a change of 10′ in declination – always positive.
dr' = the change of refraction from T_0 for the change of the Barometer and the Thermometer – positive when the refraction is increased.

$s' = s - ds$ $\quad \delta = s + d$ $\quad D = \delta + d\delta -$ $\quad d\delta = z \cos\delta + g\cos(G+\alpha) + h\cos(H+\alpha)\sin\delta$.

$$g = (\delta - s) + (d\delta + dr') + (ds - dr)$$

ds being positive when the scale reads off too large declinations

1st $d\delta$ and dr' are to be calculated for T_0, T_1 and T_2 & entered in form No 2 and the column $d\delta + dr'$ formed

2nd from the declinations of the known stars find $\delta - s$ and apply $(d\delta + dr')$ interpolated from the values just computed, and $(ds - dr)$ which increases uniformly with the declination. This gives different values of g the mean of which by weights must be used in Form No 2. to find $d = g - (d\delta + dr')$ which must be interpolated for every 10^m in Right Ascension

3rd To find the change of d for ten minutes in declination (to be added algebraically) Let $d\delta_1$ be the value of $d\delta$ for the declination corresponding to 10 of the scale Then

Change of d for 10′ in declination $= (d\delta - d\delta_1) + (ds - dr)$

In which for an equatorial star $\quad dr = dr_0 + 0''.135 \tan^2 h.$
$= dr_0 + d_h r.$

Note

That the values of d are to be tested on a known star.

Table of values of $d_h r = 0''.135 \tan^2 h$ = change dr for h

h	$d_h r$
$0^h.30^m$	$+0''.00$
1..00	.01
1..30	.02
2..00	.04
2..30	.08
3..00	+0.13

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Tables of corrections used in the Reductions

Change of ref for Barometer & Thermometer. $d_r k$ = Correction of k for Refraction

δ	dr_0	Rise of 0.10 in Bar	Fall of 1° in Ther.	Hour angle	$d_r k$
−20°	+0".78	+0.38	+0".23	0h 30m	± 0s.004
−10	.45	.25	.16	1 00	0.007
0	.30	.18	.11	1 30	0.011
+10	.23	.12	.07	2 00	0.014
+20	+ .20	+0.08	+0.05	2 30	± 0.017

$dr = dr_0 + 0".135 \tan z'h$ near meridian & equator.

For the Scale A $ds = +1".50$ for 10′ in Declination.

" " (used for Zones 8 to 17 inclusive)

" B $ds = +0".072\ (65°.8 - t°)$ t = Ther. Fahr.

" B $ds = +0".062\ (67.0 - t°)$. Used for Zone 18 & following Zones

See Table

The value of Scale B deduced from transits of Polaris is.

$$10\ ds = 10'.00".00 + \overset{0.062}{\overset{"}{0.072}}\ (t - 67.-)$$

~~$(t - 65°.8)$~~

from Obs. April 28th and July 7th 1852.

Two and one half hours from the meridian the value of the correction in declination is 0".04 larger than by above table at the equator if the table is entered with the true $\delta = 0°$ $dr = 0".30$ ref corr^n $h = 2h\ 34m = 0".36$

Cor^n in R for $d\delta = 10'$ is 0s.015 + cor^n for setting of position circle depending on change of refraction for a change of 10′ in hour angle

Total = 0s.015 + 0.007 = 0s.022 $= \pm 0^s.028 \sin h$ + for h west

1st In W hour angles at equator, stars transit earlier in the N part of the field than in the S part by amt of correction resulting from erroneous setting of the position circle if the zero of position be determined by making a star run on the wire, because at the lower part of the field the path of the star is deflected upward by refraction. This correction is taken account of by setting the position circle.

2nd In the same hour angle the northern stars transit relatively ~~later~~ earlier by the refraction in R.

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OBSERVATORY OF HARVARD COLLEGE.

REDUCTION OF ZONES.

[Form, No. 1.]

ZONE 1

H	250° 10′	$\cdot = i$	0.88762
α	150° 00′	$\cos\delta$	0.00000
$H+\alpha$	40° 10′	c'	0.88762 = −7.72″
$\sin(H+\alpha)$	9.80957	$\cos(H+\alpha)$	.
$\sec\delta$	0.00000	$\sin\delta$	. cs
$\cdot = h$	1.27669	h	.
b	1.08626 = +12.20″	b'	. = 0.00
G	139° 40′		
$G+\alpha$	289° 40′		
$\sin(G+\alpha)$	9.97390	$\cos(G+\alpha)$	9.52705
$\tan\delta$	. cs		
$\cdot = g$	.	g	.35218
a	. = 0.00	a'	9.87923 = +0.76
	f = −3.95		6.96
$d\alpha$ in seconds of arc =	+8.25	$d\delta$	= −6.96
	$-\frac{1}{3}$ 2.75		h m s α = 10 ″ 00.00.550
$d\alpha$ in seconds of time =	s. +0.550	δ =	+0° 09′ 53.04″

H	250° 10′	$\cdot = i$	.
α	175° 00′	$\cos\delta$	.
$H+\alpha$	65° 10′	c'	= −7.72″
$\sin(H+\alpha)$	9.95786	$\cos(H+\alpha)$	.
$\sec\delta$	0.00000	$\sin\delta$	. cs
$\cdot = h$	1.27669	h	.
b	1.23455 = +17.16″	b'	. = .
G	″		
$G+\alpha$	″		
$\sin(G+\alpha)$	.	$\cos(G+\alpha)$	9.84694
$\tan\delta$	. cs		
$\cdot = g$	.	g	0.35218
a	. = 0.00	a'	0.19912 = +1.58
	f = −3.95		−6.14
$d\alpha$ in seconds of arc =	+13.21	$d\delta$	= −6.14
	$-\frac{1}{3}$ 4.40		h m s α = 11 ″ 40.00.881
$d\alpha$ in seconds of time =	s. +0.881	δ =	+0° 09′ 53.86″

H	250° 10′	$\cdot = i$	0.88762
α	162° 30′	$\cos\delta$	0.00000
$H+\alpha$	52 ″ 40′	c'	0.88762 = −7.72″
$\sin(H+\alpha)$	9.90043	$\cos(H+\alpha)$	.
$\sec\delta$	0.00000	$\sin\delta$	. cs
$\cdot = h$	1.27669	h	.
b	1.17712 = +15.04″	b'	. = 0.00
G	139° 40′		
$G+\alpha$	302° 10′		
$\sin(G+\alpha)$	.	$\cos(G+\alpha)$	9.72622
$\tan\delta$	. cs		
$\cdot = g$	.	g	0.35218
a	. = 0.00	a'	0.07840 = +1.22
	f = −3.95		6.50
$d\alpha$ in seconds of arc =	+11.09	$d\delta$	= −6.50
	$-\frac{1}{3}$ 3.70		h m s α = 10 ″ 50.00.739
$d\alpha$ in seconds of time =	s. +0.739	δ =	+0° 09′ 53.50″

H	° ′	$\cdot = i$	.
α	″	$\cos\delta$	.
$H+\alpha$	″	c'	= .
$\sin(H+\alpha)$	.	$\cos(H+\alpha)$	.
$\sec\delta$	.	$\sin\delta$	.
$\cdot = h$	.	h	.
b	. = .	b'	. = .
G	° ′		
$G+\alpha$	″		
$\sin(G+\alpha)$	.	$\cos(G+\alpha)$	.
$\tan\delta$	.		
$\cdot = g$	.	g	.
a	. = .	a'	. = .
f =	.		
$d\alpha$ in seconds of arc =	.	$d\delta$	= .
	$-\frac{1}{3}$.		° ′ α = ″
$d\alpha$ in seconds of time =	s. .	δ =	

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REDUCTION OF ZONES.

ZONE 1 [Form, No. 2.]

Sidereal Time = 10 h. 12 m.	Barometer = 29.930 in.	Att. Thermometer = 63. °	Ext. Thermometer = 36.0 °
" = 12 " 12	" = 29.933	" = 62.	" = 35.0
	+.003		−1.0

α h. m.	$d\alpha$ s.	dt s.	$d\alpha+dt$ s.	p s.	$k=p-d\alpha-dt$ s.
10 " 00	+0.550	−0.000	+0.550	+2.410	+1.860
10 " 50	0.739	0.034	+0.705	2.410	+1.705
11 " 40	+0.881	−0.069	+0.812	2.410	+1.598

α h. m.	$d\delta$ "	dr' "	$d\delta+dr'$ "	q "	$d=q-d\delta-dr'$ "
10 " 00	−6.96	+0.00	−6.96	−38.1	−31.14
10 " 50	6.50	+0.05	6.45	−38.1	−31.65
11 " 40	−6.14	+0.09	−6.05	−38.1	−32.05

Change of k for +10′ in Dec. = 0.00 s.

Change of d for +10′ in Dec. = −1.2 "

α h. m.	$\delta=+0°\,00'$ k s.	$\delta=+0°\,10'$ k s.	$\delta=+0°\,00'$ d "	$\delta=+0°\,10'$ d "
10 " 00	+1.86	.	−31.1	−32.3
" 10	.82	.	31.2	32.4
" 20	.78	.	31.3	32.5
" 30	.76	.	31.4	32.6
" 40	.73	.	31.5	32.7
" 50	+1.70	.	−31.6	−32.8
11 " 00	.67	.	31.7	−32.9
" 10	.65	.	31.8	−33.0
" 20	.63	.	31.9	33.1
" 30	.61	.	32.0	33.2
11 " 40	+1.60	.	−32.0	−33.2
"	.	.	.	.

N.B. The figures in blue ink are those which have been derived from the final reductions made in 1853 & are to be used in the copy for the press.

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Zone 1 & 2

Equations of Condition for k, using $k' = 0.00$

$$a - t = k' = x + x't + x''t^2$$

$t_0 = 10^h$

	Zone 1				Zone 2		
$10^h 14^m$	$+0^s.20$	$= x_1 + 0.23\,x'_1 + 0.05\,x''_1$		w =	$+0^s.10$	$= x_2 + 0.23\,x'_2 + 0.05\,x''_2$	
10.22	−0.02	$= x_1 + 0.37$	$+0.12$		$+0.00$	$= 37$	12
10.56	−0.07	$= x_1 + 0.93$	$+0.86$		$+0.04$	$= 0.93$	0.86
11.28	$+0.08$	$= x_1 + 1.48$	$+2.19$		$+0.18$	$= 1.48$	2.19
11.39	−0.38	$= x_1 + 1.49$	$+2.22$		$+0.02$	$= 1.49$	2.22
11.33	−0.31	$= x_1 + 1.55$	$+2.40$		$+0.21$	$= 1.55$	2.40
11.53	---	---	---		$+0.01$	$= 1.88$	3.53

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Stars contained in Zones 1-2 & 3 from R $10^h 14^m$ to $11^h 54^m$

Dec $0^\circ 0'$ to $+0^\circ 10'$ — Taken from Mr Runkle's General Catalogue for 1853.0

W_1 = Weisse Z_1 = Taylor S_2 = Struve, Pos. Mell. BAC

W_2 = Wrottesley S_1 = Santini A_1 = Airy 12 year Cat.

	No	Magn	R 1853.0	Dec 1853.0	Obs.	No	Mag	R 1853.0	Dec 1853.0	Obs.
W_1	244	7-8	$10^h 14^m 32^s.25$	$-0^\circ 00' 40''.7$	1	1002	6-7	$10^h 55^m 43^s.46$	$+0^\circ 02' 37''.1$	1
W_2	1									
Z_1			33.09	43.1				43.54	30.5	
S_1										
S_2								Lalande 43.54	44.3	
A_1				Ed. Obs				Ed. Obs. 43.39	Ed. Obs 35.4	
BAC.				48.8					26.5	
Adopted Mean			32.65	− 44.2				43.44	34.8	
Prec. to 1852.0			− 3.07	+ 18.0				− 3.07	+ 19.2	
For 1852.0			$10^h 14^m 29.58$	$-0^\circ 00' 26''.2$				$10^h 55^m 40.37$	$+0^\circ 02' 54''.0$	
Zone 1			29.38	− 28.9				40.44	48.7	
" 2			29.48	− ~~32.5~~				40.33	49.5	
Zone 3			29.49	− 30.0				40.37	47.1	
$R-Z_1$			+ .20	+ 2.7				+ .07	+ 5.3	
$R-Z_2$			+ .10	+ 6.3				+ 04	+ 4.5	
$R-Z_3$			+ .09	+ 3.8				.00	+ 6.9	

Debris a Airy discordant.

W_1	405	5-6	$10^h 22^m 46^s.86$	$+0^\circ 06' 56''.6$	1	68	9	$11^h 05^m 19^s.70$	$+0^\circ 01' 11''.5$	
W_2										
Z_1			46.87	56.5						
S_1	735	5.6	46.46	53.5	3					
S_2			~~46.46~~							
A_1			Ed. Obs 46.46	Ed. Obs. 56.7					~~11.5~~	
BAC	3597	6	46.73	53.3					~~+19.3~~	
Adopted Mean			46.57	55.0				11.. 05.. 19.70	+0.. 01.. ~~30.8~~	
Prec. to 1852.0			− 3.07	+18.2				−3.07	19.3	
For 1852.0			$10^h 22^m 43.50$	$+0^\circ 07' 13''.2$				$11^h 05^m 16.63$	$+0^\circ 01' 30''.8$	
Zone 1			43.52	09.1						
2			43.50	10.3						
3			43.55	10.9						
$R-Z_1$			− .02	+ 4.1						
$R-Z_2$			00	+ 2.9						
$R-Z_3$			− .05	+ 2.3						

N.B. This star is missing.

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W 241	11.. 14.. 29.88	0.. 10.. 39.0
z_1	− 3.04	+ 19.7
1852.0 z_2	11.. 14.. 26.84	0.. 10 .. 58.7
z_3		

W 497	11.. 28.. 36.54	0.. 07.. 22.2
	− 3.04	+ 19.9
	11.. 28.. 33.50	0.. 07 .. 42.1
z_1	28.. 33.42	0.. 7 .. 36.5
z_2	33.32	37.7
z_3	33.36	36.0
$R - z_1$	+ .08	+ 5.6
$R - z_2$	+ .18	+ 4.4
$R - z_3$	+ .14	+ 6.1

490	11.. 28.. 16.28	0.. 01.. 23.9
	− 3.04	+ 19.9
	11.. 28 .. 13.19	0.. 1 .. 43.8

N B. This star not found

W 583	11.. 33.. 23.98	0.. 08.. 24.4
	− 3.04	+ 19.9
	11.. 33 - 20 .94	0.. 08 .. 44.3
z_1	33.. 21.25	8.. 43.3
z_2	21 15	42.4
z_3	21.24	44.9
	− .31	+ 1.0
	− .21	+ 1.9
	− .30	− 0.6

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W 907 11.. 52.. 52.90 — 3.04 = 11 52.. 49.86

Z_1 49.85
Z_2 49.95
Z_3

R-Z_1 —
R-Z_2 +.01
R-Z_3 −.09

0.. 07.. 31.1 + 20.0 = 0.. 07 51.1

50.4
51.8

+ 0.7
− 0.7

Cor in R

Zone 1	wt	Z_2	Z_3
+.20	2	+10	+.09
−.02	3	00	−05

	wt	$(x_n - x_0)^2 w_n$
R-$\frac{1}{3}(Z_1+Z_2+Z_3)$ = +.13	2	0.051
−02	3	.000
−01	3	.001
+14	1	.029
−26	1	.053
−03	1	.000
−09	4	.014
	n−1 = 6	0.148 prob. error

$$\varepsilon = \sqrt{\frac{(x_1-x_0)^2 w_1 + (x_2-x_0)^2 w_2 + \dots}{n-1}} = 0.6745 \sqrt{\frac{(x_1-x_0)^2 w_1' + (x_2-x_0)^2 w_2' + \dots}{n-1}}$$

x_1 = observed value
x_0 = mean of n observed values
w_1 = weight

$\sqrt{\frac{0.148}{6}} = \sqrt{0.0247} = 0.16$

$\varepsilon = 0.674 \times 0.16 = \pm 0^s.108$

$w_1 + w_2 + \dots = 15$ $\quad \varepsilon_0 = \frac{0.108}{\sqrt{15}} = \pm 0^s$

By weights Correction of mean zero $-0^s.03 \pm 0^s.03$

Prob. error of a single zero by one star of the value $w = 1$ $= \pm 0^s.108$

Cor in Dec

		$x_n - x_0$	Dec
R-$\frac{1}{2}(Z_1+Z_2+Z_3)$ =	+4".3	2	+ 0.9	−0.. 01
	+3.1	4	− 0.3	+ 7
	+5.5	2	+ 2.1	+ 2
	+5.4	1	+ 2.0	+ 7
	+0.8	1	− 2.6	+ 8
	+0.0	1	− 3.4	+ 7
	+3.5	4	+ 0.1	− 1
By wts	+3".4 ± 0".4			

S_2 11.. 29.. 25.22
W 511 .. 11.. 29.. 25.14
Y_1 25.81
S_1 795 25.33
A_1 25.32
BAC 25.40

11.. 29.. 25.3552
− 3.04
11.. 29.. 22.5128

		− 0.. 00.. 43.5	
		− 0.. 00.. 48.8	
		− 44.6	
		− 46.9	
		− 46.4	
		− 46.1	
		− 0.. 00.. 48.25.8	
		+ 19.9	
		− 0.. 00.. 28.5	− 25.9
		− 0.. 00.. 29.8	− 29.8
		29.2	29.2
		29.8	29.8
		+ 3.2	+ 3.9
		+ 2.6	3.3
		+ 3.2	+ 3.5

$\Sigma w_n \varepsilon_n^2 = 33.1$
$n - 1 = 6$
$\frac{\Sigma w_n \varepsilon_n^2}{n-1} = 5.52$

$0.674 \sqrt{5.52} = \pm 1".6$

$\Sigma w = 15$
$\varepsilon_0 = \frac{1".6}{\sqrt{15}} = \pm 0".4$

Results (Independent of adjacent Zones)

Zone 1
$k_0' = k - 0^s.03 - 0^s.007 = k_0 - 0^s.037$
$d_0' = d + 3".4 + 0".07 = d + 3".47$

Zone 2
$k_0' = k - 0^s.03$ $\quad d_0' = d + 3".4$

Zone 3
$k_0' = k - 0^s.03 + 0^s.016 = k - 0^s.014$
$d_0 = d + 3".4 + 0".73 = d + 4".13$

$R - Z_1$ −.18
Z_2 +.07
Z_3 −.18

in R $Z_2 - Z_1 = -0^s.007$ by 70 stars
$Z_3 - Z_2 = -0.016$ 115 "

in Dec $Z_2 - Z_1 = +0".07$ by 70 stars
$Z_3 - Z_2 = -0.73$

The probable error of these values of k $= \pm 0^s.03$ } for absolute zero.
" d $= \pm 0".04$ }

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OBSERVATORY OF HARVARD COLLEGE.

REDUCTION OF ZONES.

ZONE 2 April 16, 1852 [Form, No. 1.]

H	240 ° 50 ′	$\cdot = i$	0″.85974
α	150 ° 00 ′	$\cos\delta$	0.00000
$H+\alpha$	30 ° 50 ′	c'	0.85974 = −7″.24
$\sin.(H+\alpha)$	9.96973	$\cos.(H+\alpha)$	.
$''\ \sec\delta$	0.00000	$\sin\delta$	∞
$\cdot = h$	1.28081	h	.
b	0.99054 = +9″.78	b'	. = 0″.00
G	131 ° 34 ′		
$G+\alpha$	281 ° 34 ′		
$\sin.(G+\alpha)$	.	$\cos.(G+\alpha)$	9.30213
$''\ \tan\delta$	∞		
$\cdot = g$	.	g	0.30320
a	. = 0″.00	a'	9.60533 = +0″.40
	$f = -3.07$		−6.84
	+6.71	$d\delta$	= −6.84
$d\alpha$ in seconds of arc =	+6.71	α =	h m s 10 ″ 00 .. 00.447
$-\frac{1}{3}$	2.24		
$d\alpha$ in seconds of time =	s. +0.447	δ =	+0° .. 09′ .. 53″.16

H	240 ° 50 ′	$\cdot = i$	.
α	175 ° 00 ′	$\cos\delta$	.
$H+\alpha$	55 ° 50 ′	c'	= −7″.24
$\sin.(H+\alpha)$	9.91772	$\cos.(H+\alpha)$	.
$''\ \sec\delta$	0.00000	$\sin\delta$	∞
$\cdot = h$	1.28081	h	.
b	1.19853 = +15″.80	b'	. = 0″.00
G	° ′ ″		
$G+\alpha$	″		
$\sin.(G+\alpha)$	.	$\cos.(G+\alpha)$	9.77507
$''\ \tan\delta$	∞		
$\cdot = g$	.	g	0.30320
a	. = 0″.00	a'	0.07827 = +1″.20
	$f = -3.07$		−6.04
	12.73	$d\delta$	= −6.04
$d\alpha$ in seconds of arc =	+12.73	α =	h m s 11 ″ 40 .. 00.849
$-\frac{1}{3}$	4.24		
$d\alpha$ in seconds of time =	s. +0.849	δ =	+0° .. 09′ .. 53″.96

H	240 ° 50 ′	$\cdot = i$	.
α	162 ° 30 ′	$\cos\delta$	.
$H+\alpha$	43 ° 20 ′	c'	= −7″.24
$\sin.(H+\alpha)$	9.83648	$\cos.(H+\alpha)$	.
$''\ \sec\delta$	0.00000	$\sin\delta$	∞
$\cdot = h$	1.28081	h	.
b	1.11729 = +13″.10	b'	. = 0″.00
G	° ′ ″		
$G+\alpha$	″		
$\sin.(G+\alpha)$	.	$\cos.(G+\alpha)$	9.61045
$''\ \tan\delta$	∞		
$\cdot = g$	.	g	0.30320
a	. = 0″.00	a'	9.91365 = +0″.82
	$f = -3.07$		
	+10.03	$d\delta$	= −6.42
$d\alpha$ in seconds of arc =	+10.03	α =	h m s 10 ″ 50 .. 00.669
$-\frac{1}{3}$	3.34		
$d\alpha$ in seconds of time =	s. +0.669	δ =	+0° .. 09′ .. 53″.58

H	° ′ ″	$\cdot = i$	.
α	″	$\cos\delta$	.
$H+\alpha$	″	c'	= .
$\sin.(H+\alpha)$	.	$\cos.(H+\alpha)$	.
$''\ \sec\delta$	.	$\sin\delta$	.
$\cdot = h$	.	h	.
b	. = ″	b'	. = .
G	° ′ ″		
$G+\alpha$	″		
$\sin.(G+\alpha)$	.	$\cos.(G+\alpha)$	.
$''\ \tan\delta$	.		
$\cdot = g$	.	g	.
a	. = .	a'	. = .
	$f =$.		
		$d\delta$	= .
$d\alpha$ in seconds of arc =	.	α =	° ′ ″
$-\frac{1}{3}$	.		
$d\alpha$ in seconds of time =	s. .	δ =	

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OBSERVATORY OF HARVARD COLLEGE.

REDUCTION OF ZONES.

ZONE 2

[Form, No. 2.]

Sidereal Time = 9 h. 25 m.
" = 12 h. 35 m.

Barometer = 29.748 in.
" = 29.800

Att. Thermometer = 64.°
" = 62.°

Ext. Thermometer = 39.5°
" = 38.5°

α h. m.	$d\alpha$ s.	dt s.	$d\alpha+dt$ s.	p "	$k=p-d\alpha-dt$ "
10 h. 00 m.	+0.447	−0.000	+0.447	+0.366	−0.081
10 h. 50 m.	0.669	0.016	.653	.366	.287
11 h. 40 m.	+0.849	−0.034	+0.815	.366	−0.449

α h. m.	$d\delta$ "	dr' "	$d\delta+dr'$ "	q "	$d=q-d\delta-dr'$ "
10 h. 00 m.	−6.84	+0.00	−6.84	−7.50	−0.66
10 h. 50 m.	6.42	0.08	−6.34	7.50	−1.16
11 h. 40 m.	−6.04	+0.16	−5.88	−7.50	−1.62

Change of k for +10′ in Dec. = 0.000 s.

Change of d for +10′ in Dec. = −1.6 "

See Book R Reduction of Zones

α h. m.	$\delta=+0°\,00'$ k s.	$\delta=+0°\,10'$ k s.	$\delta=+0°\,00'$ d "	$\delta=+0°\,10'$ d "
10 h. 00 m.	−0.08		−0.7	−2.3
10 10	.13		0.8	2.4
10 20	.17		0.9	2.5
10 30	.21		1.0	2.6
10 40	.25		1.1	2.7
10 50	−0.29		−1.2	2.8
11 00	.32		1.2	2.8
11 10	.36		1.3	2.9
11 20	.39		1.4	3.0
11 30	.42		1.5	3.1
11 40	−0.45		−1.6	3.2
11 50	.48		−1.7	3.3
12 00	−0.50		−1.7	−3.3

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1853

Comparison of Zones 1, 2 & 3 with 49 & 50
for correction of zero. Each being derived from Catalogue stars only 2nd Rell.
On reduction of Zones 49 & 50

	in α	wt	in δ	wt
$\frac{1}{2}(z_2+z_3)-\frac{1}{2}(z_{49}+z_{50})$	$+0^s.017$	19	$+2''.52$	15

Corrected to Mutual Coincidence of z_1 z_2 & z_3

	p	wt	q	wt
By Catalogue Stars	$p_1 = +2.450 - 0.037 = +2^s.413$	3	$q_1 = -40''.9 + 3''.4 = -37''.5$	3
By Zones 49 & 50	$2.413 - 0.017 \quad 2.396$	1	$= -37.5 - 2.5 = -40.0$	1
Final Adopted	$p_1 = +2.418$	$\pm 0^s.03$	$q_1 = -38''.1$	$\pm 0''.3$

Zone 2

By Cat. Stars	$p_2 = +0^s.400 - 0.030 = +0^s.370$	3	$q_2 = -10''.30 + 3.40 = -6''.90$	3
Zones 49 & 50	$+0.370 - 0.017 = 0.353$	1	$-6.90 - 2.50 = -9.40$	1
	$p_2 = +0.366$	± 0.03	$q_2 = -7''.50$	$\pm 0''.3$

Zone 3

By Cat Stars	$p_3 = +0^s.385 - 0.014 = +0^s.371$	3	$q_3 = -8.77 + 4.13 = -4''.64$	
	$+0.371 - 0.017 \quad +0.354$	1	$= -4.64 - 2.50 = -7.14$	
	$p_3 = +0.367$	± 0.03	$q_3 = -5''.2$	$\pm 0''.3$

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Reduction of Zones 1 and 2

In the reduction of these zones, Zone 3 which is a repetition of 2 and 49 & 50 which are those next following in right ascension have also been used

Equations of condition in ~~Right Ascension~~

Zone 1

t	$\alpha - t - k'$			$\delta - \delta - d'$
$10^h .. 14^m$	$+0^s.20$	$= x_1 + 0.23 x_1' + 0^s.05 x_1''$		$+2.'7 =$
22	$-.02$	$=$	$0.37 \quad 0.12$	$+4.1 =$
56	$-.07$	$=$	$0.93 \quad 0.86$	$+$
11 28	$+.08$	$=$	$1.48 \quad 2.19$	
29	$-.18$	$=$	$1.49 \quad 2.22$	
33	$-.31$	$=$	$1.55 \quad 2.40$	
~~59~~				

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OBSERVATORY OF HARVARD COLLEGE.

REDUCTION OF ZONES.

ZONE 3 April 17 1852

[Form, No. 1.]

H	° ′ ″	$\cdot = i$	″
α	,,	cos. δ	
$H+\alpha$	,,	c'	= ″
sin. $(H+\alpha)$		cos. $(H+\alpha)$	
sec. δ		sin. δ	
$= h$		h	
b	= ″	b'	=
G	° ′ ,,		
$G+\alpha$	,,		
sin. $(G+\alpha)$		cos. $(G+\alpha)$	
tan. δ			
$= g$		g	
a	=	a'	=
$f =$			
$d\alpha$ in seconds of arc =		$d\delta$	=
$-\frac{1}{2}$		$\alpha =$	° ′ ,,
$d\alpha$ in seconds of time =	s.	$\delta =$	

H	° ′ ″	$\cdot = i$	″
α	,,	cos. δ	
$H+\alpha$	,,	c'	= ″
sin. $(H+\alpha)$		cos. $(H+\alpha)$	
sec. δ		sin. δ	
$= h$		h	
b	= ″	b'	=
G	° ′ ,,		
$G+\alpha$	,,		
sin. $(G+\alpha)$		cos. $(G+\alpha)$	
tan. δ			
$= g$		g	
a	=	a'	=
$f =$			
$d\alpha$ in seconds of arc =		$d\delta$	=
$-\frac{1}{2}$		$\alpha =$	° ′ ,,
$d\alpha$ in seconds of time =	s.	$\delta =$	

H	° ′ ″	$\cdot = i$	″
α	,,	cos. δ	
$H+\alpha$	,,	c'	= ″
sin. $(H+\alpha)$		cos. $(H+\alpha)$	
sec. δ		sin. δ	
$= h$		h	
b	= ″	b'	=
G	° ′ ,,		
$G+\alpha$	,,		
sin. $(G+\alpha)$		cos. $(G+\alpha)$	
tan. δ			
$= g$		g	
a	=	a'	=
$f =$			
$d\alpha$ in seconds of arc =		$d\delta$	=
$-\frac{1}{2}$		$\alpha =$	° ′ ,,
$d\alpha$ in seconds of time =	s.	$\delta =$	

H	° ′ ″	$\cdot = i$	″
α	,,	cos. δ	
$H+\alpha$	,,	c'	= ″
sin. $(H+\alpha)$		cos. $(H+\alpha)$	
sec. δ		sin. δ	
$= h$		h	
b	= ″	b'	=
G	° ′ ,,		
$G+\alpha$	,,		
sin. $(G+\alpha)$		cos. $(G+\alpha)$	
tan. δ			
$= g$		g	
a	=	a'	=
$f =$			
$d\alpha$ in seconds of arc =		$d\delta$	=
$-\frac{1}{2}$		$\alpha =$	° ′ ,,
$d\alpha$ in seconds of time =	s.	$\delta =$	

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OBSERVATORY OF HARVARD COLLEGE.

REDUCTION OF ZONES.

ZONE 8

[Form, No. 2.]

Sidereal Time	Barometer	Att. Thermometer	Ext. Thermometer
h. m.	in.	°	°
9 „ 45'	30·050	67.	39·7
„ = 12 „ 30	„ = 30.047	" = 64.	" = 37.6

α	$d\alpha$	dt	$d\alpha+dt$	p	$k=p-d\alpha-dt$
h. m.	s.	s.	s.	"	" s
10 „ 00	+0·436	−0.000	+0·436	+0.367	−0.069
10 „ 50	0·663	−0.017	0.646	0.367	.279
11 „ 40	+0.845	−0.034	+0.811	0.367	−0.444

α	$d\delta$	dr'	$d\delta+dr'$	q	$d=q-d\delta-dr'$
h. m.	"	"	"	" "	" "
10 „ 00	−6·83	+0·00	−6·83	−5.20	+1.63
10 „ 50	−6.41	+0.07	−6.34	−5.20	+1.14
11 „ 40	−6.03	+0.15	−5.88	−5.20	+0.68

Change of k for +10′ in Dec. = s. 0.00

Change of d for +10′ in Dec. = " −1.7

α	k ($\delta=+0°\,00'$)	k ($\delta=+0°\,10'$)	d ($\delta=+0°\,00'$)	d ($\delta=+0°\,10'$)
h. m.	s.	s.	"	"
10 „ 00	−0.07		+1.6	−0.1
„ 10	12		1.5	0.2
„ 20	.16		1.4	0.3
„ 30	.20		1.3	0.4
„ 40	.24		1.2	0.5
„ 50	.28		+1.1	0.6
11 „ 00	−0.32		1.0	0.7
„ 10	.35		0.9	0.8
„ 20	.38		0.8	0.9
„ 30	.41		0.7	1.0
„ 40	.44		+0.7	1.0
„ 50	.47		0.6	1.1
12 „ 00	−0.50		+0.5	−1.2

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OBSERVATORY OF HARVARD COLLEGE.

REDUCTION OF ZONES.

ZONE 4 April 27, 1852

[Form, No. 1.]

H	229° 43′	$=i$	0ⁿ.80754
α	150° 00′	cos. δ	0.00000
$H+\alpha$	19° 43′	c'	0.80754 = −6″.42
sin. $(H+\alpha)$	9.52811	cos. $(H+\alpha)$	9.97396
sec. δ	0.00000	sin. δ	7.46373
$=h$	1.28735	h	1.28735
b	0.81546 = +6″.53	b'	8.72484 = +0.06
G	117° 15′		
$G+\alpha$	267° 15′		
sin. $(G+\alpha)$	9.99990	cos. $(G+\alpha)$	8.68104
tan. δ	7.46373		
$=g$	0.25285	g	0.25285
a	7.71504 = −0.01	a'	8.93389 = −0.09
	$f=-1.90$		−6.51
	−1.91		06
	+6.53	$d\delta$	= 6.45
$d\alpha$ in seconds of arc	= +4.62		h m s
$-\frac{1}{3}$	1.54	α =	10 00 00.308
$d\alpha$ in seconds of time	= +0.308	δ =	+0 09 53.55

H	229° 38′	$=i$	0.80754
α	180° 00′	cos. δ	0.00000
$H+\alpha$	49° 38′	c'	0.80754 = −6.42
sin. $(H+\alpha)$	9.88148	cos. $(H+\alpha)$	9.81195
sec. δ	0.00000	sin. δ	7.46373
$=h$	1.28735	h	1.28735
b	1.16883 = +14.75	b'	8.56303 = +0.04
G	117° 08′		
$G+\alpha$	297° 08′		
sin. $(G+\alpha)$	9.94936	cos. $(G+\alpha)$	9.65902
tan. δ	7.46373		
$=g$	0.25285	g	0.25285
a	7.66594 = −0.01	a'	9.91187 = +0.82
	$f=-1.90$		+0.86
	−1.91		−6.42
	+14.75	$d\delta$	= −5.56
$d\alpha$ in seconds of arc	= 12.84		h m s
$-\frac{1}{3}$	4.28	α =	12 00 00.856
$d\alpha$ in seconds of time	= +0.856	δ =	+0 09 54.44

H	h m 22 40	$=i$	0.80754
α	165° 00′	cos. δ	0.00000
$H+\alpha$	34° 40′	c'	0.80754 = −6.42
sin. $(H+\alpha)$	9.75496	cos. $(H+\alpha)$	9.91512
sec. δ	0.00008	sin. δ	7.46373
$=h$	1.28735	h	1.28735
b	1.04231 = +11.02	b'	8.66620 = +0.05
G	117° 12′		
$G+\alpha$	282° 12′		
sin. $(G+\alpha)$	9.99008	cos. $(G+\alpha)$	9.32495
tan. δ	7.46373		
$=g$	0.25285	g	0.25285
a	7.70666 = −0.01	a'	9.57780 = +0.38
	$f=-1.90$		+0.43
	−1.91		−6.42
	+11.02	$d\delta$	= −5.99
$d\alpha$ in seconds of arc	= 9.11		h m s
$-\frac{1}{3}$	3.03	α =	11 00 00.608
$d\alpha$ in seconds of time	= +0.608	δ =	+0 09 54.01

H	° ′	$=i$	.
α	″	cos. δ	.
$H+\alpha$	″	c'	= ″ .
sin. $(H+\alpha)$	.	cos. $(H+\alpha)$	.
sec. δ	.	sin. δ	.
$=h$	.	h	.
b	. = ″ .	b'	. = .
G	° ′		
$G+\alpha$	″		
sin. $(G+\alpha)$	.	cos. $(G+\alpha)$	.
tan. δ	.		
$=g$	.	g	.
a	. = .	a'	. = .
	$f=$.		
$d\alpha$ in seconds of arc	= .	$d\delta$	= .
$-\frac{1}{3}$	.	α =	° ′ ″
$d\alpha$ in seconds of time	= .	δ =	

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OBSERVATORY OF HARVARD COLLEGE.

REDUCTION OF ZONES.

ZONE 4 [Form, No. 2.]

Sidereal Time = 11 h. 30 m.	Barometer = 29.732 in.	Att. Thermometer = 69.0 °	Ext. Thermometer = 42.0 °
" = 13 h. 27 m.	" = 29.756	" = 70.0	" = 40.5

α h. m.	$d\alpha$ s.	dt s.	$d\alpha+dt$ s.	p "	$k=p-d\alpha-dt$ "
10 h. 00 m.	+0.308	+0.000	+0.308	+0.880	+0.572
11 h. 00 m.	0.607	0.033	.640	0.880	0.240
12 h. 00 m.	+0.856	+0.065	+0.921	+0.880	+0.041

α h. m.	$d\delta$ "	dr' "	$d\delta+dr'$ "	q "	$d=q-d\delta-dr'$ "
10 h. 00 m.	−6.45	+ 0.00	−6.45	−10.20	3.75
11 h. 00 m.	6.00	+ 0.10	5.90	10.20	4.35
12 h. 00 m.	−5.56	+ 0.20	−5.36	10.20	4.84

Change of k for +10′ in Dec. = 0.000 s. Change of d for +10′ in Dec. = −1.65 "

	$\delta=+0°\,10'$	$\delta=+0°\,20'$	$\delta=+0°\,10'$	$\delta=+0°\,20'$
α h. m.	k s.	k s.	d "	d "
10 h. 00 m.	+0.57	.	−3.7	−5.4
" 10	.51	.	3.8	5.5
" 20	.45	.	3.9	5.6
" 30	.40	.	4.0	5.7
" 40	.34	.	4.1	5.8
" 50	.29	.	4.2	5.9
11 h. 00 m.	.24	.	4.3	6.0
" 10	.19	.	4.4	6.0
" 20	.14	.	4.5	6.1
" 30	.09	.	4.5	6.2
" 40	.05	.	4.6	6.3
" 50	.00	.	4.7	6.4
12 h. 00 m.	0.04		4.8	6.5

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Stars in Zones 4 & 5 from Mr Runkles Catalogue

R 10h 17m to 12h 00m Dec 0° 10′ to 0° 20′

W 299 — 10h 17m 19.93 — 0° 20′ 35″.2
−3.07 — +18.1
10h 17m 16.86 — 0° 20′ 53″.3
Not in Zone

W 241 — 11h 14m 29.88 — 0° 10′ 39″.0
−3.07 — +19.7
11h 14m 26.81 — 0° 10′ 58″.7
Z_4 26.82 — 58.5
Z_5 26.84 — 59.8
−.01 — +0.2
−.03 — −1.1

α = Mean R of Star α′ = α by reduction before made
δ = " Dec δ′ = δ "
δ′ =

Comparison of previous reduction

W 694 — 10h 39m 13.01 — 0° 17′ 34″.7
Jmc — −3.07 — +18.8
α 1852.0 — 10h 39m 09.94 — δ 0° 17′ 53″.5
α′ Z_4 — 09.89 — δ′ 50.6
Z_5 — 9.96 — 51.2
α−α′ — −.05 — δ−δ′ +2.9
α−t — +.02 — +2.3

814 — 11h 47m 29.31 — 0° 15′ 38″.9
−3.07 — +20.0
11h 47m 26.24 — 0° 15′ 58″.9
Z_4 26.42 — 16″.5
Z_5 ---- — ----
−.18 — −2.6

772 — 10h 42m 58.49 — 0° 17′ 40″.4
43?
−3.07 — +18.9
10h 42m 55.42 — 0° 17′ 59″.3
Z_4 43m 55.23 — 58.6
Z_5 55.19 — 58.1
+.19 — +0.7
+.23 — +1.2

Zone 4

α−α′	wt	δ−δ′	wt
−.05	1	+2.9	1
+.19	1	+0.7	1
−.01	1	+0.2	1
−.18	1	−2.6	1
−.01	4	−0.3	3
−0s.010	8	+0″.04	7

1011 — 11h 59m 39.57 — 1 — 0° 11′ 14″.2 — 1
Sant. 826 — 40.04 — 3 — 16.4 — 2
11h 59m 39.92 — 0° 11′ 15″.7
−3.07 — +20.0
1852.0 — 11h 59m 36.85 — 0° 11′ 35″.7
Z_4 36.86 — 0° 11′ 36″.0
Z_5 ---- — ----
−.01 — −0.3

Zone 5

α−α′	wt	δ−δ′	wt
+.02	1	+2″.3	1
+.23	1	+1.2	1
−.03	1	−1.1	1
+.07	3	+0″.8	3

By Catalogue Stars Cor. of α′ Zone 4 = −0s.01 — 8 — δ′ +0″.0 — 7
" " 5 = +.07 — 3 — +0.8 — 3

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Correction of Previous reduction

$\mathfrak{Z}_4 - \mathfrak{Z}_5$

	$\alpha_4 - \alpha_5$	$\delta_4 - \delta_5$
$10^h.17$	~~-02~~	+0".8
	+.13	+0.7
	-03	+0.6
	+23	-1.3
	+08	+0.7
	+13	+0.4
	+03	+0.6
	-17	+1.7
	-07	+0.6
	-03	+0.2
10.25	-08	10
	-.33	
	+60	
	10) +27	
$\alpha_4 - \alpha_5$ =	+0.027	$\delta_4 - \delta_5$ +0".5 10 Obs
"	+.045	" -0.4 "
Mean	+0.036	+0".05

$\mathfrak{Z}_4 - \mathfrak{Z}_5$

	$\alpha_4 - \alpha_5$	$\delta_4 - \delta_5$
$11^h.13$	+.19	~~+1.3~~
	-.02	-1.5
	-.02	-0.5
	+28	-0.5
	+03	-0.4
	+03	-0.4
	+07	+1.6
	-07	-1.5
	-02	-0.7
	-02	-0.5
	+60	+0.5
	15	+2.1
	45	-60
	+0.045	3.9

Beg. of Zone $\delta_4 - \delta_5 = -0".4$ 10 Obs

End "

These are corrections of K and used in reducing Zones 425 as far as

depending upon their mutual agreement

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OBSERVATORY OF HARVARD COLLEGE.

REDUCTION OF ZONES.

ZONE 5 April 28 1852 [Form, No. 1.]

H	228° 42′	i	0ⁿ.80209
α	150° 00	cos. δ	0.00000
$H+\alpha$	378° 42	c	0.80209 = −6.34
sin. $(H+\alpha)$	9.50598	cos. $(H+\alpha)$	9.97645
sec. δ	0.00000	sin. δ	7.46373
h	1.28847	h	1.28847
b	0.79445 = +6.23	b'	8.72865 = +0.05
G	115° 39′		
$G+\alpha$	265° 39		
sin. $(G+\alpha)$	9.99875	cos. $(G+\alpha)$	8.87995
tan. δ	7.46373		
g	0.24797	g	0.24797
a	7.71045 = −0.00	a'	9.12792 = −0.13
f	= −1.78		−6.47
	4.45		.05
$d\alpha$ in seconds of arc	= +4.45	$d\delta$	= −6.42
	−⅓ 1.48	α	= 10h 00m 00.297
$d\alpha$ in seconds of time	= +0.297	δ	= +0° 09′ 53.58

H	228° 42′	i	0.80209
α	170° 00	cos. δ	0.00000
$H+\alpha$	398° 42	c	0.80209 = −6.34
sin. $(H+\alpha)$	9.79605	cos. $(H+\alpha)$	9.89233
sec. δ	0.00000	sin. δ	7.46373
h	1.28847	h	1.28847
b	1.08452 = +12.15	b'	8.64453 = +0.04
G	115° 39′		
$G+\alpha$	285° 39		
sin. $(G+\alpha)$	9.98359	cos. $(G+\alpha)$	9.43098
tan. δ	7.46373		
g	0.24797	g	0.24797
a	7.69529 = −0.00	a'	9.67895 = +0.48
f	= −1.78		0,52
	10.37		6.34
$d\alpha$ in seconds of arc	= +10.37	$d\delta$	= +6.82
	−⅓ 3.46	α	= 11h 20m 00.691
$d\alpha$ in seconds of time	= +0.691	δ	= +0° 09′ 54.18

H	228° 42′	i	0.80209
α	160°	cos. δ	0.00000
$H+\alpha$	388° 42	c	0.80209 = −6.34
sin. $(H+\alpha)$	9.68144	cos. $(H+\alpha)$	9.94307
sec. δ	0.00000	sin. δ	7.46373
h	1.28847	h	1.28847
b	0.96991 = +9.33	b'	8.69527 = +0.05
G	115° 39′		
$G+\alpha$	275° 39		
sin. $(G+\alpha)$	9.99788	cos. $(G+\alpha)$	8.99322
tan. δ	7.46373		
g	0.24797	g	0.24797
a	7.70958 = −0.00	a'	9.24119 = +0.17
f	= −1.78		+0,22
	+7.55		−6.34
$d\alpha$ in seconds of arc	= +7.55	$d\delta$	= −6.12
	−⅓ 2.52	α	= 10h 40m 00.503
$d\alpha$ in seconds of time	= +0.503	δ	= +0° 9′ 53.88

H	° ′	i	
α		cos. δ	
$H+\alpha$		c'	=
sin. $(H+\alpha)$		cos. $(H+\alpha)$	
sec. δ		sin. δ	
h		h	
b	=	b'	=
G	° ′		
$G+\alpha$			
sin. $(G+\alpha)$		cos. $(G+\alpha)$	
tan. δ			
g		g	
a	=	a'	=
f	=		
$d\alpha$ in seconds of arc	=	$d\delta$	=
	−⅓	α	= ° ′
$d\alpha$ in seconds of time	=	δ	=

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OBSERVATORY OF HARVARD COLLEGE.

REDUCTION OF ZONES.

ZONE 5 [Form, No. 2.]

Sidereal Time = 11 h. 30 m.
" = 14 h. 30 m.

Barometer = 29.830 in.
" = 29.844
+ .014

Att. Thermometer = 66.° "
" = 65.

Ext. Thermometer = 40.0 °
" = 39.2
− 0.8 + 0.09
0.03
3) 0.12
1h 0.04
2h 0.08
0.04

α h. m.	dα s.	dt s.	dα+dt s.	p "	k = p − dα − dt "
10 h 00 m	+ 0.297	0.000	+0.297	+ 0.477	+0.180
10 h 40 m	0.503	+0.010	0.513	.477	− .036
11 h 20 m	+ 0.691	+0.025	+0.716	+0.477	−0.239

α h. m.	dδ "	dr' "	dδ+dr' "	q "	d = q − dδ − dr' "
10 h 00 m	−6.42	+0.00	−6.42	− 11.80	− 5.38
10 h 40 m	6.12	0.03	−6.09	11.80	5.71
11 h 20 m	−5.82	+0.05	−5.77	− 11.80	− 6.03

dδ − 6.12
dδ₁ − 6.07
dδ − dδ₁ − 0.05
(dδ − dr) +1.60
− 1.65

Change of k for +10′ in Dec. = 0.000 s.

Change of d for +10′ in Dec. = −1.90 + 0.30 − 0.05 = −1.65 "

δ = 0 ° 10 ′ δ = ° ′ δ = 0 ° 10 ′ δ = 0 ° 20 ′

α h. m.	k s.	k s.	d "	d "
10 h 00 m	+ 0.18	.	−5.4	− 7.0
" 10	.12	.	5.4	7.1
" 20	.07	.	5.5	7.1
" 30	+ 0.01	.	5.6	7.2
" 40	− 0.04	.	−5.7	−7.3
" 50	.09	.	5.8	7.4
11 h 00 m	.14	.	5.9	7.5
" 10	.19	.	6.0	7.6
11 h 20 m	− 0.24	.	−6.0	−7.7
" 30	.	.	.	.
" 40	.	.	.	.
"	.	.	.	.

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10.00	da +0.297	$d\delta$ −6.42	
10.40	da +0.503	$d\delta$ −6.12	
11.20	da +0.691	$d\delta$ −5.62	

No. 35

α 10.39.09.54
t 10.39.10.00
$\alpha - t$ −.06
$d\alpha + dt$ +.51
$p = +.45$

No. 91

α 11.14.26.80
t 14.27.05
$\alpha - t$ −.25
$d\alpha + dt$ +.69
p +.44

No. 35

δ +00.17.53.0
δ 17.58.0
$\delta - \delta = -5.00$
$d\delta + d\delta'$ −6.10
$d\delta - d\alpha$ +1.30
$q = -9.80$

No. 91

δ +0.10.58.15
δ 11.06.00
$\delta - \delta$ −07.85
$d\delta + d\delta'$ −5.86
$d\delta - d\alpha$ +.16
13.55

.203 5 6 .090

+16 +F −A4 1.6 for 10 0.16

Dif. R

$Z^4 - Z^5$	$Z^4 - Z^5$
$10^h.22^m$	11.18
+.06	−.24
+.21	+.11
+.05	−.19
+.30	−.19
−.15	−.14
+.19	−.30
+.09	−.25
+.11	−.26
+.03	−.06
+.03	−.26
+.107	189
−.15	+.11
10).92	10)178
+.092	+.018
$da + dt$ .41	$da + dt$ +.50
+.501	+.52

p by Zones +.510
by cat. .445
.955
$p = +.477$

Dif. δ

Z_4	Z_5	$d\delta - d\alpha$
−5.1	+0.5	
−5.1	+0.4	
−5.0	0.2	
−4.9	0.2	
−4.9	0.1	
−4.9	+0.0	
−4.9	0.0	
−4.0	0.2	
$\delta - \delta$	−5.1	
$d\delta - d\alpha$	+0.2	
$10^h.21^m$ $d\delta + d\alpha'$	−6.3	
q	−11.2	

$Z_4 - Z_5$		
−9.5	+1.2	$11^h.16^m$
−6.7	+0.4	
−6.9	+0.5	
−8.2	+0.7	
−6.7	+0.2	$11^h.26$
30	3.0	
−7.6		$\delta - \delta$
+0.6		$d\delta - d\alpha$
−5.8		$d\delta + d\alpha'$ $11^h.20$
q −12.8		End
−11.2		Beginning
q −12.0		from Zones
−11.6		from Cat.
$q = -11.8$		

Catalogue
−9.8
−13.5
23.3
−11.6

Test

No 91

α 11.14.26.80 $\quad \delta$ +0°.10'.58".15
l
t 11.14.27.05 $\quad \delta$ +0.11.06.0
k +0.21 $\quad d$ −6.2
11.14 26.84 $\quad$ 0.10 59.8

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OBSERVATORY OF HARVARD COLLEGE.

REDUCTION OF ZONES.

ZONE 6 — April 29, 1852 — [Form, No. 1.]

H	227° 47′	i	0ⁿ.79518
α	165° 00	cos. δ	0.00000
$H+\alpha$	392° 47	c'	0.79518 = −6″.24
sin. $(H+\alpha)$	9.73357	cos. $(H+\alpha)$	9.92465
sec. δ	0.00000	sin. δ	7.46373
h	1.28892	h	1.28892
b	1.02249 = 10″.53	b'	6.67730 = 0.05
G	114° 05′		
$G+\alpha$	279° 05′		
sin. $(G+\alpha)$	9ⁿ.99452	cos. $(G+\alpha)$	9.19830
tan. δ	7.46373		
g	0.24551	g	0.24551
a	7ⁿ.60376 = −0.00	a'	9.44381 = 0.28
	f = −1.66		−5.91
	8.87	$d\delta$	= −5.91
$d\alpha$ in seconds of arc =	8.87		h m s
$-\frac{1}{3}$	2.96	α =	11 00 00.59
$d\alpha$ in seconds of time =	s. +0.591	δ =	+00° 09′ 54″.09

H	227° 47′	i	0ⁿ.79518
α	195° 00	cos. δ	0.00000
$H+\alpha$	422° 47	c'	0.79518 = −6″.24
sin. $(H+\alpha)$	9.94404	cos. $(H+\alpha)$	9.66025
sec. δ	0.00000	sin. δ	7.46373
h	1.28892	h	1.28892
b	1.23296 = 17″.30	b'	8.41290 = 0.02
G	114° 05′		
$G+\alpha$	309° 05′		
sin. $(G+\alpha)$	9ⁿ.88999	cos. $(G+\alpha)$	9.79965
tan. δ	7.46373		
g	0.24551	g	0.24551
a	7ⁿ.59923 = −0.00	a'	0.04516 = 1.11
	f = −1.66		−5.11
	15.64	$d\delta$	= −5.11
$d\alpha$ in seconds of arc =	15.64		h m
$-\frac{1}{3}$	5.21	α =	13 00 58.96
$d\alpha$ in seconds of time =	s. 1.043	δ =	+00° 09′ 54″.89

H	227° 47′	i	0ⁿ.79518
α	180° 00	cos. δ	0.00000
$H+\alpha$	407° 47	c'	0ⁿ.79518 = −6″.24
sin. $(H+\alpha)$	9.86959	cos. $(H+\alpha)$	9.82733
sec. δ	0.00000	sin. δ	7.46373
h	1.28892	h	1.28892
b	1.15851 = 14″.41	b'	8.57998 = 0.04
G	114° 05′		
$G+\alpha$	294° 05′		
sin. $(G+\alpha)$	9ⁿ.96045	cos. $(G+\alpha)$	9.61073
tan. δ	7.46373		
g	0.24551	g	0.24551
a	7ⁿ.66969 = −0.00	a'	9.85624 = 0.72
	f = −1.66		−5.48
	12.75	$d\delta$	= −5.48
$d\alpha$ in seconds of arc =	+12.75		h m s
$-\frac{1}{3}$	4.25	α =	12 00 00.85
$d\alpha$ in seconds of time =	s. +0.850	δ =	+0 09 54.52

H	° ′	i	.
α		cos. δ	.
$H+\alpha$		c'	= .
sin. $(H+\alpha)$	.	cos. $(H+\alpha)$	.
sec. δ	.	sin. δ	.
h	.	h	.
b	. = .	b'	. = .
G	° ′		
$G+\alpha$			
sin. $(G+\alpha)$	.	cos. $(G+\alpha)$	.
tan. δ	.		
g	.	g	.
a	. = .	a'	. = .
	f = .		
		$d\delta$	= .
$d\alpha$ in seconds of arc =	.		° ′
$-\frac{1}{3}$	.	α =	″
$d\alpha$ in seconds of time =	s. .	δ =	

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OBSERVATORY OF HARVARD COLLEGE.

REDUCTION OF ZONES.

ZONE 6 [Form, No. 2.]

Sidereal Time = 11 h. 05 m.
" = 14 h. 00

Barometer = 29.830 in.
" = 29.860
.030
0".05

Att. Thermometer = 65°
" = 63

Ext. Thermometer = 49.6°
" = 42.8
6.8
0".75

0.75
05
3)0.80
0.27

α h. m.	dα s.	dt s.	dα+dt s.	p "	k = p − dα − dt "
11 " 00	+ 0.591	+ 0.000	+ 0.591	+ 0.405	− 0.186
12 " 00	0.850	0.010	0.860	.405	− 0.455
13 " 00	+ 1.043	0.020	1.063	+ 0.405	− 0.658

α h. m.	dδ "	dr' "	dδ+dr' "	q "	d = q − dδ − dr' "
11 " 00	− 5.91	+ 0.00	− 5.91	−13.41.30.40	− 7.54 − 7.34 − 7.49
12 " 00	− 5.48	0.27	5.21	13.41.30.40	− 8.24 8.04 8.14
13 " 00	− 5.11	+ 0.54	− 4.57	13.41.30.40	− 8.88 − 8.73 − 8.83

dδ − 5.48
dδ' − 5.44
dδ − dδ' = − .04
dδ − dr = + 1.60
change = − 1.64
of d.

Change of k for +10' in Dec. = 0.000 s.

scale ref. dif dδ
Change of d for +10' in Dec. = − 1.40 + 0.30 − 0.04 = − 1.64

δ = + 0° 10' δ = + 0° 20' δ = + 0° 10' δ = + 0° 20'

α h. m.	k s.	k s.	d "	d " ×	used in Reductions
11 " 0	− 0.19	.	− 7.54	− 7.45	− 9.0 − 9.1 dif − 1.64
" 10	.24	.	7.67	7.56	9.1 9.2
" 20	.29	.	7.80	7.67	9.2 9.3
" 30	.33	.	7.91	7.85	9.3 9.4
" 40	.38	.	8.02	7.94 8.0	9.5 9.6
" 50	.42	.	8.13	8.0 8.1	9.6 9.7
12 " 00	− 0.46	.	− 8.24	− 8.1 8.2	− 9.7 9.8
" 10	.50	.	8.36	8.2 8.3	9.8 9.9
" 20	.53	.	8.46	8.3 8.4	9.9 10.0
" 30	.56	.	8.57	8.4 8.5	10.0 10.1
" 40	.60	.	8.68	8.5 8.6	10.2 10.3
" 50	.63	.	8.78	8.6 8.7	10.3 10.4
13 " 00	− 0.66	.	− 8.88	− 8.7 88	− 10.4 − 10.5

The Zone was reduced in declination using the scale readings for arguments which corresponded to a declination 1' more greater than the true. The corrections in red ink answer to the true declination for the argument.

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Reduction of Zone 6

No. 3	No. 33	No. 55	No. 73	No. 84	No. 91
11h 14m 27.00	11h 33m 21.20	11h 47m 26.70	11h 59m 37.35	12h 11m 39.00	12h 12m 20.70
corr to mean +0.64	+.73	+.79	+.85	+.88	+.89
11 14 26.36	11 33 20.47	11 47 25.91	11 59 36.50	12 11 38.88	12 12 19.81
11 14 26.80	11 33 20.61	11 47 26.25	11 59 36.90	12 11 38.62	12 12 20.13
.44	.14	.34	1.40	1.50	.32
			W2		W3

No. 120	No. 123	No. 131	No. 158
12h 32m 26.00	12h 33m 29.20	12h 39m 05.95	12h 58m 36.85
+.95	+.96	+.98	−1.03
12 32 26.95	12 33 28.24	12 39 04.97	12 58 35.82
12 32 25.27	12 33 28.54	12 39 05.51	12 58 36.29
1.22	1.30	1.54	.47

$$p = (a - t) + (da + dt)$$

No 3		No. 33		No. 55			No. 73		
a = 11 14 26.80	da = +0.64	a 11 33 20.61	da = +0.73	a	11 47 26.25	da = +0.79	a	11 59 36.90	da +0.85
t = 11 14 27.00	dt = +0.00	t 11 33 21.20	dt +0.00	t	47 26.70	dt +0.00	t	59 37.35	dt +.01
a − t = −0.20	da+dt = +0.64	a − t = −0.59	+0.73		+.45	+0.79		−.45	+0.86
da+dt = +0.64		+0.73			+.79			+.86	
p = +0.44		+.14			+.34			+.41	

No. 84		No. 91		No. 120		No. 123		No. 131	
12 11 38.62	da +.88	12 12 20.13	da +.89	12 32 25.27	da +.95	12 33 28.54	da +.96	12 39 05.51	da +.98
12 11 39.00	dt +.01	20.70	dt +.01	12 32 26.00	dt +.01	12 33 29.20	dt +.01	12 39 05.95	dt +.01
a − t −.38	+.89	−.57	+.90	−.73	+.96	−.66	+.97	−.44	+.99
+.89		+.90		+.96		+.97		+.99	
+.51		+.33		+.23		+.31		+.55	

No. 158	
12 58 36.29	da +1.03
12 58 36.85	dt +.02
−.56	+1.05
+1.05	
+.49	

By comparison with Catalogue Stars $p = +0^s.37$
" Zone 4 $= +0.44$
adopted value of $p = +0.405$

11h 16m	11.56
Y2	Y6
−.17	−.27
−.33	−.46
−.18	−.52
−.34	−.17
+.06	−.38
+.16	−.48
−.37	−.33
+.27	−.48
+.29	−.39

11h 16m	11.56	
−.22	−.39	= a − t
+.66	+.84	da + dt
p = +0.44	+0.45	

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D No. 3 +0° 11′ 06″ — 0.17 ds + 5.84 0,11,11.67 10,58.15 dr′ −13.52 +0.07 13,45

No. 33 +0° 08′ 52″ + 0.17 ds + 5.71 0,08,57.88 8,4413 dr′ −13.75 +0″.15 13.60

No. 55 +0° 16′ 10″ − 0.96 ds +5.58 0,16,14.62 15,58.76 −15.66 +0.22 16,64

No. 73 +0° 11′ 44″ − 0.26 ds + 5.48 0,11,49.22 11,35.68 −13,54 +0.27 W=2 13.27

No. 89 +0° 13′ 35″ − 0.56 ds + 5.42 0,13,39.86 13,27.02 −12,84 +0.32 12,52

No. 91 +0° 09′ 25″ + 0.14 ds + 5.41 0,09,30.55 9,22.02 −8.53 +.33 W=2 8.20

D No. 120 +0° 17′ 10″ − 1.14 ds + 5.30 0,17,14.16 16,58.24 −15.92 +0.41 15.51

No. 123 +0° 11′ 46″ — 0.26 ds + 5.30 0,11,51.04 11,38,51 −12,53 +0.42 12,11

No. 131 +0° 08′ 56″ + 0.18 ds + 5.24 0,09,01.42 8,45.80 −15.62 +0.48 16,14

No. 155 +0° 09′ 25″ +0.14 ds +5.13 0,09,30.27 9,15.12 dr′ −15.15 + 0.53 14,62

No 3

δ +0° 11′ 06″

dδ − 0.17

δ′ 0° 11′ 5.83

δ 0° 10′ 58.15

δ − δ′ − 7.68

dδ + dr′ − 5.77

q = −13.45

Zone 6 − Zone 7

7.5 −0.2
8.2 +0.2
9.2 −0.2
8.4 −0.1

11.14 8.4 − 0.1 = 8.″3

dδ + dr′ = 5.7

q = 14.0

Zone 6 − Zone 7

8.7 −0.8
7.7 −1.2
8.8 −1.0
8.2 −0.3
7.6 −0.8
10 0.8

11h 23m 8.2

ds − 8

7.4
5.6
13.0

By Zone 6 Catalogue

Zone 6 − Zone 7

8.2 +0.3
8.2 −0.8
~~9.6~~ −1.2
8.0 −0.5
9.1 −0.6
9.1 − 0.8

12h 55 8.7 − 06

ds −0.6

8.1
4.6
12,7

q = −12.8
−13.8
q = −13.3
−0.1 corr for i = dif between Scale & Zone dec.
q −13.4 adopted.

7.6 −1.0
7.5 −0.8
8.7 −1.0
7.5 −0.7
6.6 0.0
7.4 −0.8

δ 0° 10′ 58.″15
δ 0° 11′ 6.″
δ − δ −7.85
dδ + dr′ − 5.77
ds − dr + 0.17
q −13.45

12h 52m

Catalogue q

−13.45
13.60
15.64
13.27
13.27
12.52
8.20
15.51
12.11
15.14
14.62
3733
8.20
12/45.53
q = −13.80

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OBSERVATORY OF HARVARD COLLEGE.

REDUCTION OF ZONES.

ZONE 7

[Form, No. 1.]

H	222° 55′	i	0.″76193
α	165° 00	cos. δ	0.00000
$H+\alpha$	27° 55′	c	0.76193 = −5.″78
sin. $(H+\alpha)$	9.67042	cos. $(H+\alpha)$	9.94627
sec. δ	0.00000	sin. δ	7.46373
h	1.29203	h	1.29203
b	0.96245 = +9.″17	b'	8.70203 = +0.05
G	105° 29′		
$G+\alpha$	270° 29		
sin. $(G+\alpha)$	9.99998	cos. $(G+\alpha)$	7.92612
tan. δ	7.46373		
g	0.23553	g	0.23553
a	7.69924 = −0.00	a'	8.16165 = +0.01
	f = −1.04		−5.72
	+8.13	$d\delta$	= −5.72
$d\alpha$ in seconds of arc	= +8.13		h m s
	−⅓ 2.71	α	= 11 00 00.542
$d\alpha$ in seconds of time	= +0.s542	δ	= +0° 9′ 54.28

H	222° 55′	i	0.76193
α	185°	cos. δ	0.00000
$H+\alpha$	47° 55′	c	0.76193 = −5.″78
sin. $(H+\alpha)$	9.87050	cos. $(H+\alpha)$	9.82621
sec. δ	0.00000	sin. δ	7.46373
h	1.29203	h	1.29203
b	1.16253 = +14.″54	b'	8.58197 = +0.04
G	105° 29′		
$G+\alpha$	290° 29		
sin. $(G+\alpha)$	9.97163	cos. $(G+\alpha)$	9.54399
tan. δ	7.46373		
g	0.23553	g	0.23553
a	7.67089 = −0.00	a'	9.77952 = +0.60
	f = −1.04		+0.64
	13.50		−5.78
$d\alpha$ in seconds of arc	= +13.50	$d\delta$	= −5.14
	−½ 4.50		h m s
$d\alpha$ in seconds of time	= +0.s900	α	= 12 20 00.900
		δ	= +0° 9′ 54.86

H	222° 55′	i	0.″76193
α	175° 00	cos. δ	0.00000
$H+\alpha$	37° 55′	c	0.76193 = −5.″78
sin. $(H+\alpha)$	9.78853	cos. $(H+\alpha)$	9.89702
sec. δ	0.00000	sin. δ	7.46373
h	1.29203	h	1.29203
b	1.08056 = +12.″04	b'	8.55278 = +0.04
G	105° 29′		
$G+\alpha$	280° 29		
sin. $(G+\alpha)$	9.99269	cos. $(G+\alpha)$	9.25995
tan. δ	7.46373		
g	0.23553	g	0.23553
a	7.69195 = −0.00	a'	9.49548 = +0.31
	f = −1.04		+0.35
	+11.00		−5.78
$d\alpha$ in seconds of arc	= 11.00	$d\delta$	= −5.43
	−⅓ 3.67		h m s
$d\alpha$ in seconds of time	= +0.s733	α	= 11 40 00.733
		δ	= +0° 9′ 54.57

H	222° 55′	i	0.76193
α	195°	cos. δ	0.00000
$H+\alpha$	57° 55′	c	0.76193 = −5.″78
sin. $(H+\alpha)$	9.92803	cos. $(H+\alpha)$	9.72522
sec. δ	0.00000	sin. δ	7.46373
h	1.29203	h	1.29203
b	1.22006 = +16.″60	b'	8.46098 = +0.03
G	105° 29′		
$G+\alpha$	300° 29		
sin. $(G+\alpha)$	9.93539	cos. $(G+\alpha)$	9.70525
tan. δ	7.46373		
g	0.23553	g	0.23553
a	7.63465 = −0.00	a'	9.94078 = +0.87
	f = −1.04		4.88
	15.56	$d\delta$	= −4.88
$d\alpha$ in seconds of arc	= +15.56		h m
	−½ 5.18	α	= 13 00 01.038
$d\alpha$ in seconds of time	= +1.s038	δ	= +0° 9′ 55.12

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OBSERVATORY OF HARVARD COLLEGE.

REDUCTION OF ZONES.

ZONE 7

[Form, No. 2.]

Sidereal Time = 11h 50m
" = 13h 35

Barometer = 30.346 in.
" = 30.316

Att. Thermometer = 65.°
" = 64.

Ext. Thermometer = 45.° 0
" = 44.8

α h. m.	dα s.	dt s.	dα+dt s.	p "	k = p − dα − dt "
11 0	+0.542	0.000	+0.542	+0.710	+0.168
12 0	.667	−0.012	0.805	.710	−0.095
13 0	+1.038	−0.024	+1.014	+0.710	−0.304

α h. m.	dδ "	dr' "	dδ+dr' "	q "	d = q − dδ − dr' "
11 00	−5.72	−0.00	−5.72	−12.60	−6.88
12 00	5.29	0.01	5.30	12.60	−7.30
13 00	−4.88	−0.02	−4.90	−12.60	−7.70

Change of k for +10′ in Dec. = 0.000 s.

Change of d for +10′ in Dec. = −1.″90 + 0.″30 − 0.″04 = −1.64

α h. m.	δ = +0° 10′ k s.	δ = ° ′ k s.	δ = +0° 10′ d "	δ = +0° 20′ d "
11 0	+0.17	.	−6.9	−8.6
10	+0.12	.	7.0	8.7
20	+0.08	.	7.0	8.8
30	+0.04	.	7.1	8.8
40	−0.00	.	7.2	8.9
50	−0.05	.	7.3	9.0
12 00	−0.09	.	−7.3	−9.0
10	−0.13	.	7.4	9.1
20	−0.16	.	7.4	9.1
30	−0.20	.	7.5	9.2
40	−0.23	.	7.6	9.2
50	−0.27	.	7.6	9.3
13 00	−0.30	.	−7.7	−9.3

1.7

1.6

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No 3

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11.14	11.33	11.47	11.59
No 3	35	55	73
0.11.5	0.8.52	0.16.09	0.11.43
dδ − 0.2	+ 0.2	− 0.0	− 0.3
δ 0.11.4.8	0.8.52.2	0.16.8.0	0.11.42.7
10.58.1	8.44.1	15.58.8	11.35.7
− 6.7	8.1	9.2	7.0
dδ+dν' − 5.7	5.5	5.4	5.3
−12.4	13.6	14.6	12.3 W=2
W 88 12.11	90	116	119
13.34	12h.12 9.37	12.42 17.10	12h.33 11.43
− 0.5	+0.1	− 0.1	− 0.3
0.13.33.5	0.9.37.1	0.17.8.9	0.11.42.7
13.27.0	9.22.0	16.58.2	11.38.5
6.5	5.1	10.7	4.2
5.2	5.2	5.1	5.1
11.7	W= 10.3	15.8	9.3
127	129 12.58		
12h.39 8.56	9.25		
+0.2	+0.1		
0.8.56.2	0.9.25.1		
8.45.8	9.15.1		
10.4	10.0		
5.0	4.9		
15.4	14.9		

12.4
13.6
14.6
W=2 12.3
11.7
W=2 10.3
15.8
9.3
15.4
14.9
30 3
2 3
0.3
12)32 9
9 = −12.8 By Catalogue
−12 3 By Zone 4
9 −12.6

By Zone 4

11h.16m mean δ 5 −6.9 = δ.5 dδ+dν'
−5.7
9 −12,6
11.9
−12.3 By Zone 4

11h.56 −6.6
5.3
−11.9

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OBSERVATORY OF HARVARD COLLEGE.

REDUCTION OF ZONES.

ZONE 8

[Form, No. 1.]

H	134° 59′	i	0.77743	H	134° 59′	i	0.77743
α	270° 00	cos. δ	0.00000	α	285° 00	cos. δ	0.00000
$H+\alpha$	44° 59	c'	0.77743 = 5.″99	$H+\alpha$	59° 59	c'	0.77743 = 5.″99
sin. $(H+\alpha)$	9.84936	cos. $(H+\alpha)$	9.84961	sin. $(H+\alpha)$	9.93746	cos. $(H+\alpha)$	9.69919
sec. δ	0.00000	sin. δ	∞	sec. δ	0.00000	sin. δ	∞
h	1.29048	h	1.29048	h	1.29048	h	1.29048
b	1.13584 = 13.″80	b'	1.14009 = 0.00	b	1.22794 = 16.″90	b'	0.98967 = 0.00
G	7° 51′			G	7° 51′		
$G+\alpha$	277° 51′			$G+\alpha$	292° 51′		
sin. $(G+\alpha)$	9.99591	cos. $(G+\alpha)$	9.13539	sin. $(G+\alpha)$	9.96451	cos. $(G+\alpha)$	9.58919
tan. δ	∞			tan. δ	∞		
g	0.76641	g	0.76641	g	0.76641	g	0.76641
a	0.76232 = 0.00	a'	9.90180 = 0.80	a	0.73092 = 0.00	a'	0.35560 = 2.27
f	= 13.29		6.79	f	= 13.29		8.26
$d\alpha$ in seconds of arc	= 27.09	$d\delta$	= 6.79	$d\alpha$ in seconds of arc	= 30.19	$d\delta$	= 8.02
	−⅓ 9.13		h m s		−⅓ 10.06		h m s
$d\alpha$ in seconds of time	= +1.826	α	= 18° 00′ 01.83	$d\alpha$ in seconds of time	= 2.012	α	= 19° 00′ 02.01
		δ	= +00° 00′ 06.79			δ	= +00° 00′ 08.02

H	134° 59′	i	0.77743	H	° ′	i	0.77743
α	300° 00	cos. δ	0.00000	α	° ′	cos. δ	0.00000
$H+\alpha$	74° 59	c'	0.77743 = 5.″99	$H+\alpha$	° ′	c'	0.77743 = 5.″99
sin. $(H+\alpha)$	9.98491	cos. $(H+\alpha)$	9.41347	sin. $(H+\alpha)$	.	cos. $(H+\alpha)$	9.69919
sec. δ	0.00000	sin. δ	∞	sec. δ	.	sin. δ	7.46373
h	1.29048	h	1.29048	h	.	h	1.29048
b	1.27539 = 18.″85	b'	0.70395 = 0.00	b	. = ″ .	b'	8.45340 = 0.028
G	7° 51′			G	° ′		
$G+\alpha$	307° 51′			$G+\alpha$	° ′		
sin. $(G+\alpha)$	9.89742	cos. $(G+\alpha)$	9.78788	sin. $(G+\alpha)$	.	cos. $(G+\alpha)$	.
tan. δ	∞			tan. δ	.		
g	0.76641	g	0.76641	g	.	g	.
a	0.66383 = 0.00	a'	0.55429 = 3.58	a	. = .	a'	. = .
f	= 13.29		9.57	f	= .		
$d\alpha$ in seconds of arc	= 32.14	$d\delta$	= 9.57	$d\alpha$ in seconds of arc	= .	$d\delta$	= .
	−⅓ 10.71		h m s		−⅓ .	α	= ° ′ ″
$d\alpha$ in seconds of time	= 2.142	α	= 20° 00′ 02.14	$d\alpha$ in seconds of time	= .	δ	=
		δ	= +0° 00′ 09.57				

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OBSERVATORY OF HARVARD COLLEGE.

REDUCTION OF ZONES.

ZONE 8 [Form, No. 2.]

Sidereal Time = 17h 55m
" = 21 15
+ 3 20

Barometer = 30.000 in.
" = 30.010
+ .010

Att. Thermometer = 70°
" = 70

Ext. Thermometer = 67.8
" = 65.0
− 2.8

+0.02
+0.31
3.3 +0.33

dr' for 4 +0.100
" 2 +0.200

α h. m.	dα s.	dt s.	dα+dt s.	p s	k = p − dα − dt s
18 00	+1.826	−0.000	+1.826	+1.980	+0.154
19 00	+2.012	−0.017	+1.995	+1.980	−0.015
20 00	+2.142	−0.034	+2.108	+1.980	−0.128

α h. m.	dδ "	dr' "	dδ + dr' "	q "	d = q − dδ − dr' "
18 00	+6.79	+.00	+6.79	+5.88	−0.91
19 00	+8.26	.10	+8.36	5.88	−2.48
20 00	+9.57	+.20	+9.77	5.88	−3.89

Change of k for +10' in Dec. = s.

Change of d for +10' in Dec. = −0.04 (dδ − dδ₁) − ds + dr
+0.04 +0.30
= +0.30

α h. m.	δ = 00° 00' k s.	δ = +0° 10' k s.	δ = 0° 00' d "	δ = +0° 10' d "
18 00	+0.15	+0.15	−0.9	−0.6
10	.15	+.12	1.2	0.9
20	.11	+.09	1.5	1.2
30	.07	+.06	1.7	1.4
40	+.03	+.03	2.0	1.7
50	.00	+.01	2.2	1.9
19 00	−0.02	−.01	2.5	2.2
10	.04	−.04	2.7	2.4
20	.07	−.06	3.0	2.7
30	.09	−.08	3.2	2.9
40	.11	−.10	3.4	3.1
50	.13	−.11	3.7	3.4
20 00	−0.16	−.13	−3.9	−3.6

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Authorities

No. 1 — Rümker 6304
3 — " 6317 Santini 1246
15 — " 6427
20 — " 6495 " 1261 B.A.C. 6268
21 — Santini 1262 Rümker 6501
42 — Rümker 6623
76 — Weisse Hora XVIII No. 1469
100 — B.A.C. 6596 W Hora XIX No 254
106 — Santini 1338
112 — B.A.C. 6653
131 — Santini 1356
148 — Weisse H XIX No. 1088

N Aq
δ Aquila apptα = 19h 18m 4.11 = R Δ1 +2m 49s 34.0 = D
1852.0 19h 18m 2.05 = α 2m 49s 24.81 = D'
dα = +2.06 dδ = +9.19
2.051
computed comp = 9.13

9.69919 2.49'
1.29048
10.98967 in 2m.49 109'
8.69144
0.48 = 9.68111
8.65 1.03743 10.9 "
9.13 8.64368 = 0.04

dδ1 = dδ + 0".04

dδ = +8.26'
dδ1 = +8.30
dδ − dδ1 = −0.04
ds − dr −0.34
+0.30

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Zone 8 observed Aug. 9. 1852

	f	g	G	h	H	i	α 18h.00m = 270°.00
Aug.	8 + 13".17	+ 5".79	8°.10'	+ 19".53	135°.57'	+ 5".90	α 19h.00m = 285°.00
"	13 + 13.22	+ 6.04	6.34	19.41	131.8	+ 6.34	α 20h.00m = 300°.00
"	9 + 13.29	+ 5.84	7.51	+ 19.52	134.59	+ 5.99	α 19h.42m = 295°.30

1°.36' 41".45
19 255
36 58

daily rate of E.C. — 5s.40

24)400(17
24
160
168
.017

$p = (\alpha - t) + (d\alpha + dt)$

No. 1
α = 18h.06m.19s.19 dα = +1.85
t 18h.06m.19s.20 dt = +0.00
α − t = −.01 dα+dt = +1.85
dα+dt +1.85
p = +1.84

No. 3
α 18h.06m.58s.15 dα = +1.85
t 18h.06m.58s.85 dt = −0.00
α − t = +.30 dα+dt = +1.85
dα+dt +1.85
p +2.15

No. 15
α 18h.14m.33s.87 dα = +1.87
t 18h.14m.34s.00 dt = −.00
α − t = −.13 dα+dt = 1.87
dα+dt +1.87
p +1.74
1.73

No. 20
α 18h.19m.38s.29 dα = +1.88
t 18h.19m.38s.00 dt = −0.00
α − t +29 dα+dt = 1.88
dα+dt +1.88
p +2.04
.08

No. 21
α 18h.20m.15s.48 dα = +1.89
t 18h.20m.15s.25 dt = −0.00
α − t +.23 dα+dt = 1.89
dα+dt +1.89
p +2.12
2.10

No. 42
α 18h.32m.05s.26 dα = +1.93
t 18h.32m.05s.65 dt = −.00
α − t = −.39 dα+dt = 1.93
dα+dt +1.94
p +1.55
.53

No. 76
α 18h.57m.21s.25 dα +2.00
t 18h.57m.21s.20 dt −0.01
α − t +05 dα+dt = 1.99
dα+dt +1.99
p +2.04
2.01

No. 100
31
α 19h.10m.57s.42 dα = +2.03
t 19h.10m.57s.05 dt = −0.02
α − t +.37 dα+dt = 2.01
dα+dt +2.01
p +2.38
2.34
23

No. 106
α 19h.14m.46s.45 dα = +2.04
t 14h.46m.53s dt = −0.02
α − t −.10 dα+dt = 2.02
dα+dt +2.02
p = +1.92
1.88

No. 112
57.09
α 19h.18m.58s.99 dα = +2.05
t 19h.18m.57.00 dt −0.02
α − t +.09 dα+dt = 2.03
+2.03
p +2.02
2.08

No. 131
α 19h.30m.47.20 dα = +2.07
t 19h.30m.47.30 dt −0.02
α − t −.10 dα+dt = 2.05
+2.05
p +1.95
1.90

No. 148
α 19h.42m.43.61 dα = +2.09
t 19h.42m.43.30 dt = −0.02
α − t +31 dα+dt = 2.07
+2.07
p +2.38
2.32

In the first calculation dα + dt were not used exactly correct the clock rate having been applied with a wrong sign but the corrected value was used in form 2

p	
+1.84	2.01
2.15	2.23 2.34
1.73	1.88
2.04	2.08
2.10	1.90
1.53	2.32 32
11 51	12 43
1.92	2.05
	1.92
	399
p =	1.98

+1.84
2.15
1.74
2.08
2.12
1.55
2.04
2.38
1.92
2.02
1.95
2.38
12)24.17
p = 2.014
cor for rate −.034
p = +1.980

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Reduction of Zone 8 observed Aug. 9, 1852

$q = (\delta - s) + (d\delta + dr') + (ds - dr)$ $\quad ds = +0''.072\,(66°.8 - t)$

$t = 66°.4$

$\times .6$

$= .072$

$ds = +.0422$ $\quad 20 - 0''.04$

$dr + 30$ $\quad +0''.30$

$ds - dr = +0''.26$ $\quad -0''.34$

No. 1	No. 3	No. 15	No. 20	No. 21	No. 42
$\delta + 0°\ 3'\ 23''.46$	$\delta + 0°\ 08'\ 18''.54$	$\delta + 0°\ 5'\ 29''.34$	$\delta + 0°\ 06'\ 42''.94$	$\delta + 0°\ 06'\ 48''.95$	$\delta + 0°\ 1'\ 12''.29$
$s\ 0\ 3\ 20.$	$s\ 0\ 8\ 19.$	$s\ 5\ 29$	$s\ 6\ 45$	$s\ 6\ 49.$	$s\ 1\ 11$
$\delta - s = +3.46$	-0.46	$+0.34$	$\delta - s = -2.06$	$\delta - s - 0.05$	$\delta - s\ +1.29$
$d\delta + dr' + 6.93$	$d\delta + dr' + 6.95$	$d\delta + dr' + 7.36$	$d\delta + dr' + 7.40$	$d\delta + dr' + 7.40$	$d\delta + dr' + 7.60$
$ds - dr - 0.09$	$ds - dr + 0.21$	$ds - dr + 0.13$	$ds - dr - 0.16$	$ds - dr - 0.16$	$ds - dr - 0.04$
$q = +10.32$	$q + 6.29$	$q + 7.70$	$q + 5.18$	$q + 7.19$	$q + 8.85$

No. 76	No. 100	No. 106	No. 112	No. 131	No. 148
$\delta + 0°\ 00'\ 55''.87$	$\delta + 0°\ 9'\ 24''.45$	$\delta + 0°\ 06'\ 12''.76$	$\delta + 0°\ 02'\ 47''.02$	$\delta + 0°\ 00'\ 48''.70$	$\delta + 0°\ 05'\ 18''.50$
$s\ 0\ 0\ 59$	$s\ 0\ 09\ 33.80$	$s\ 6\ 17$	$s\ 2\ 54$	$s\ 0\ 54$	$s\ 5\ 17.00$
$\delta - s = -3.23$	-8.55	$\delta - s\ -4.24$	-6.98	-5.30	$+1.50$
$d\delta + dr' + 8.25$	$d\delta + dr' + 8.42$	$d\delta + dr' + 8.88$	$d\delta + dr' + 8.90$	$d\delta + dr' + 9.02$	$d\delta + dr' + 9.40$
$ds - dr - 0.02$	$ds - dr - 0.26$	$ds - dr - 0.18$	$ds - dr - .05$	$ds - dr - .03$	$ds - dr - .13$
$q + 5.00$	-0.87	$+4.46$	$+1.87$	$+5.69$	$+10.77$
	-0.39				

	t	
	$0\ 5\ 18.2$	7.19
	$5\ 17.0$	8.85
	$+1.2$	5.00
	$+9.4$	4.46
	-0.1	-0.39
	$+10.5$	1.87
		3.69
		10.875
		71.71 44
		-0.39
		$\delta(12)\ 71.32 = 5.94$

Adopted places of Reduction Stars-

		α	δ
No 1	Rumker 6304	$18^h\ 06^m\ 19^s.19$	$+0°\ 3'\ 23''.5$
No 3	Rumker 6317	18 06 59.02	0 8 17.7
	Santini 1246	59.21	19.1
	adopted	18 06 59.15	0 8 18.54
No 15	Rumker 6427	18 14 33.87	0 5 29.34
No 20	Rumker 6495	18 19 38.15	0 6 44.1
	Santini 1261	38.30	6 43.1
	B.A.C 6269	38.42	6 39.3
	adopted	18 19 38.29	0 6 42.94
No 21	Rumker 6501	18 20 15.35	0 6 49.5
	Santini 1262	15.61	6 47.4
	Adopted	18 20 15.48	0 6 48.95
No 42	Rumker 6623	18 32 5.26	0 1 12.3
No 76	Weisse H18-1469-	18 57 21.25	0 0 55.87

	α	
No 100 BAC 6596	$19^h\ 10^m\ 57^s.42$	$+0°\ 09'\ 23''.77$
Weisse H 19-254-	57.08	9 26.34
	19 10 57.31	0 9 24.45
No 106 Santini 1338	19 14 46.45	0 6 12.76
No 112 BAC 6653	19 18 57.09	0 2 47.02
No 131 Santini 1356	19 30 47.20	0 0 48.70
No 148 Weisse H 19-1088	19 42 43.61	0 5 18.2

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"
-0.04
+0.30
-0.34

94

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OBSERVATORY OF HARVARD COLLEGE.

REDUCTION OF ZONES.

ZONE 9 — Aug. 11th 1852 — [Form, No. 1.]

H	133° 04′	i	0.79099
α	270° 00	cos. δ	0.00000
$H+\alpha$	43° 04	c'	0.79099 = +6.18″
sin. $(H+\alpha)$	9.83432	cos. $(H+\alpha)$	9.86366
sec. δ	0.00000	sin. δ	∞
h	1.28937	h	1.28937
b	1.12369 = 13.30″	b'	1.15303 = 0.00
G	7° 14′		
$G+\alpha$	277° 14		
sin. $(G+\alpha)$	9.99653	cos. $(G+\alpha)$	9.10006
tan. δ	∞		
g	0.77379	g	0.77379
a	0.77032 = −0.00	a'	9.87385 = 0.75
f	= 13.53		6.93
$d\delta$			= +6.93
$d\alpha$ in seconds of arc	= +26.83	α	= 18h 00m 01.79s
$-\frac{1}{3}$	8.94		
$d\alpha$ in seconds of time	= +1.788	δ	= + 0° 00′ 06.93″

H	133° 04′	i	0.79099
α	285° 00	cos. δ	0.00000
$H+\alpha$	58° 04	c'	0.79099 = +6.18″
sin. $(H+\alpha)$	9.92874	cos. $(H+\alpha)$	9.72340
sec. δ	0.00000	sin. δ	∞
h	1.28937	h	1.28937
b	1.21811 = 16.52″	b'	1.01277 = +0.00
G	7° 14′		
$G+\alpha$	292° 14		
sin. $(G+\alpha)$	9.96645	cos. $(G+\alpha)$	9.37793
tan. δ	∞		
g	0.77379	g	0.77379
a	0.74024 = −0.00	a'	0.35172 = +2.25
f	= 13.53		8.43
	24.55		
$d\delta$			=
$d\alpha$ in seconds of arc	= 39.05	α	= 19h 00m 02.00s
$-\frac{1}{3}$	10.02		
$d\alpha$ in seconds of time	= +2.004	δ	= + 0° 00′ 08.43″

H	133° 04′	i	0.79099
α	300° 00	cos. δ	0.00000
$H+\alpha$	73° 04	c'	0.79099 = +6.18″
sin. $(H+\alpha)$	9.98075	cos. $(H+\alpha)$	9.46428
sec. δ	0.00000	sin. δ	∞
h	1.28937	h	1.28937
b	1.27012 = +18.63″	b'	0.75365 = 0.00
G	7° 14′		
$G+\alpha$	307° 14		
sin. $(G+\alpha)$	9.90101	cos. $(G+\alpha)$	9.79180
tan. δ	∞		
g	0.77379	g	0.77379
a	0.67480 = −0.00	a'	0.55559 = 3.59
f	= 13.53		9.77
	32.16		
$d\delta$			= +9.77
$d\alpha$ in seconds of arc	= 32.16	α	= 20h 00m 02.14s
$-\frac{1}{3}$	10.72		
$d\alpha$ in seconds of time	= +2.144	δ	= + 0° 00′ 09.77″

H	° ′	i	
α	″	cos. δ	
$H+\alpha$	″	c'	= ″
sin. $(H+\alpha)$		cos. $(H+\alpha)$	
sec. δ		sin. δ	
h		h	
b	= ″	b'	=
G	° ′		
$G+\alpha$	″		
sin. $(G+\alpha)$		cos. $(G+\alpha)$	
tan. δ			
g		g	
a	=	a'	=
f	=		
$d\delta$			=
$d\alpha$ in seconds of arc	=	α	= ° ′ ″
$-\frac{1}{3}$			
$d\alpha$ in seconds of time	=	δ	=

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OBSERVATORY OF HARVARD COLLEGE.

REDUCTION OF ZONES.

ZONE 9 — Aug. 11th 1852.

[Form, No. 2.]

Sidereal Time = 17h 35m	Barometer = 30.076 in.	Att. Thermometer = 68.°	Ext. Thermometer = 60.°0
" = 20 " 15	" = 30.110	" = 67.	" = 58.1
2 " 40	+.034	0".06	− 3.9

" +0.43 +0.06 2.7 +0.49 0.0182

α h. m.	dα s.	dt s.	dα+dt s.	p s.	k = p − dα − dt "
18 " 00	+ 1.788	0.000	+ 1.788	+ 1.592	− 0.196
19 " 00	2.004	−.016	1.988	1.592	− 0.396
20 " 00	2.144	−.033	+2.111	1.592	− 0.519

t = 58.1
65.8
(65.8−t) = +7.7
7½
154
539
5544

α h. m.	dδ "	dr' "	dδ+dr' "	q "	d = q − dδ − dr' "
18 " 00	+6.93	+0.00	+6.93	+4.40	−2.53
19 " 00	8.43	0.18	8.61	4.40	−4.21
20 " 00	+9.77	+0.36	+10.13	4.40	−5.73

ds = +0".55
dr = +0.30
ds − dr = +0.25 for 10'

Change of k for +10' in Dec. = 0.000 s.

Change of d for +10' in Dec. = −0.04 − 0.25 = −0.29 "

δ = 0° 00'	δ = +0° 10'	δ = 0° 00'	δ = +0° 10'

α h. m.	k s.	k s.	d "	d "
18 " 00	−0.20	.	−2.53	−2.8
" 10	.23	.	2.8	3.1
" 20	.27	.	3.1	3.4
" 30	.31	.	3.4	3.7
" 40	.34	.	3.6	3.9
" 50	.37	.	3.9	4.2
19 " 00	−0.40	.	4.21	4.7
" 10	.42	.	4.5	4.8
" 20	.45	.	4.7	5.0
" 30	.47	.	5.0	5.3
" 40	.49	.	5.2	5.5
" 50	.51	.	5.4	5.7
20 " 00	−0.52		−5.73	−6.0

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Zone 9 observed August 11, Pon. 1852

	f	g	G	h	H	i	
Aug. 8	+13.17	+5.79	8°.10'	+19.55	135°.57'	+5.90	18h.00 = 270°.00'
13	13.77	6.04	6.34	19.41	131.08	6.34	19.00 = 285.00
Aug. 11	+13.53	+5.94	7.14	+19.47	133.04	+6.18	20.00 = 300.00

No 1

	α	δ
Runker 6304	18h.06m.19.19	+0°.3'.23".5
t	18.06.19.55	0.3.22.0
α − t	− 0.36	δ − s + 1.5
dα + dt	+ 1.81	dδ + dr' + 7.1
p	+ 1.45	ds − dr + 0.1
		q + 8.7

No 2

Runker 6317	18.06.59.02	0.8.17.7
Santini 1246	59.21	19.1
α	18.06.59.15	δ 0.8.18.5
t	18.06.59.40	s 0.8.21.0
α − t	− 0.25	δ − s − 2.5
dα + dt	+ 1.81	dδ + dr' + 7.1
p	+ 1.56	ds − dr + 0.2
		q + 4.8

No. 14

Rümker 6427	α 18.14.33.87	δ +0°.6'.29".3
t	34.35	s 5.32
α − t	− 0.48	δ − s − 2.7
dα + dt	+ 1.84	dδ + dr' + 7.3
p	+ 1.36	ds − dr + 0.2
		q + 4.8

No. 20 A

Rümker 6495	α 18h.19m.38.15	δ +0°.6'.44.1
Santini 1261	38.30	43.1
B.A.C. 6269	38.42	39.3
α	18.19.38.29	δ +0.06.42.9
t	19.38.50	s 6.47
α − t	− 0.21	δ − s − 4.1
dα + dt	+ 1.86	dδ + dr' + 7.5
p	+ 1.65	ds − dr + 0.2
		q + 3.6

No. 21

Rümker 6501	α 18.20.15.35	δ +0°.6'.49.5
Santini 1262	15.61	47.9
α	18.20.15.48	δ +0.06.48.9
t	20.15.70	s 6.51
α − t	− 0.22	δ − s − 2.1
dα + dt	+ 1.86	dδ + dr' + 7.5
p	+ 1.64	ds − dr + 0.2
		q + 5.6

No. 41

Rümker 6623	α 18.32.5.26	δ +0.01.12.3
t	32.6.26	s 1.12
α − t	− 0.94	δ − s + 0.3
dα + dt	+ 1.89	dδ + dr' + 7.8
p	+ 0.95	ds − dr 0.0
		q + 8.1

No. 76

Weisse H 18 No. 1469	α 18.57.21.25	δ +0°.00'.55".9
t	57.21.60	s 1.01
α − t	− 0.35	δ − s − 5.1
dα + dt	+ 1.99	dδ + dr' + 8.5
p	+ 1.64	ds − dr 0
		q 3.4

No. 100

B.A.C. 6596	α 19.10.57.42	δ +0°.9'.23".5
Weisse H 19 254	57.08	9.26.34
	α 19.10.57.31	δ +0 9.24.45
t	10.57.30	s 9.34
α − t	+0.01	δ − s − 9.6
dα + dt	+2.02	dδ + dr' + 9.0
	+2.03	ds − dr + 0.2
		q − 0.4

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No. 106

Gautini 1338 α 19h 14m 46.45 δ +0° 6' 12.70

t	14..46.85	s	6..20
α−t	− 0.40	δ−s	− 7.3
dα+dt	+ 2.03	dδ+dr	+ 8.9
p	+ 1.63	ds−dr	+ 0.2
		q	+ 1.8

No. 111

B.A.C. 6653 α 19h 18m 57.09 δ +0° 2' 47.0

t	18..57.30	s	2..56
α−t	− 0.21	δ−s	− 9.0
dα+dt	+ 2.03	dδ+dr	+ 9.1
p	+ 1.82	ds−dr	.0
		q	+ 0.1

No. 129

Gautini 1356 α 19h 30m 49.20 δ +0° 0' 48.7

t	30..47.76	s	6 56.
α−t	− 0.50	δ−s	− 7.3
dα+dt	+ 2.05	dδ+dr	+ 9.3
p	+ 1.55	ds−dr	0
		q	+ 2.0

No. 145

Weisse 148 HXIX α 19h 42m 43.61 δ +0° 5' 18.2

t	42..43.85	s	5'18
α−t	− 0,24	δ−s	+ 0.2
dα+dt	+ 2.07	dδ+dr	+ 9.7
p	+ 1.83	ds−dr	+ 0.1
		q	+ 10.0

p	p	q	q
+ 1.45	+ 1,64	+ 8.7	+ 3.4
1.56	2,03	4.8	− 0,4
1.36	1,63	4.8	+ 1.8
1.65	1.82	3.6	+ 0.1
1.64	1.55	5.6	+ 2.0
+ 0.95	+ 1.83	+ 8.1	+ 10.0
8.61	10.50	35.6	17.7
1.435	1.75	5.9	2.9
1.75			5.9
1185			8.8
p = + 1.592			q = + 4.4

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OBSERVATORY OF HARVARD COLLEGE.

REDUCTION OF ZONES.

ZONE 10

[Form, No. 1.]

H	132° 07′	i =	0.79588
α	270° 00	cos. δ	0.00000
$H+\alpha$	42° 07	c'	0.79588 = +6.″25
sin. $(H+\alpha)$	9.82649	cos. $(H+\alpha)$	9.87028
sec. δ	0.00000	sin. δ	7.46373
h	1.28870	h	1.28870
b	1.11519 = +13.″03	b'	8.62271 = +0.04
G	6° 53′		
$G+\alpha$	276° 53		
sin. $(G+\alpha)$	9.99686	cos. $(G+\alpha)$	9.07863
tan. δ	7.46373		
g	0.77743	g	0.77743
a	8.23802 = −0.02	a'	9.85606 = 0.72
f	= 13.65		+7.01
$d\alpha$ in seconds of arc	= 26.66	$d\delta$	= 7.01
	−½ 8.88	α	= 18h 0m 1.777
$d\alpha$ in seconds of time	= 1.777	δ	= 0° 10′ 7.″01

H	132° 07′	i =	
α	295° 00	cos. δ	
$H+\alpha$	57° 07	c'	= 6.″25
sin. $(H+\alpha)$	9.92416	cos. $(H+\alpha)$	9.73474
sec. δ	0.	sin. δ	7.46373
h	1.28870	h	1.28870
b	1.21286 = 16.″32	b'	8.48717 = 0.03
G	6° 53′		
$G+\alpha$	291° 53		
sin. $(G+\alpha)$	9.96752	cos. $(G+\alpha)$	9.57138
tan. δ	7.46373		
g	0.77743	g	0.77743
a	8.20868 = −0.02	a'	0.34881 = 2.23
f	= 13.65		+8.54
$d\alpha$ in seconds of arc	= 29.95	$d\delta$	= 8.54
	−½ 9.95	α	= 19h 0m 1.991
$d\alpha$ in seconds of time	= 1.991	δ	= 0° 10′ 8.″54

H	132° 07′	i =	0.79934
α	300° 00	cos. δ	0.00000
$H+\alpha$	72° 07	c'	= +6.″26
sin. $(H+\alpha)$	9.97849	cos. $(H+\alpha)$	9.48725
sec. δ	0.00000	sin. δ	7.46373
h	1.28870	h	1.28870
b	1.26719 = 18.″50	b'	8.23968 = +0.″02
G	6° 53′		
$G+\alpha$	306° 53		
sin. $(G+\alpha)$	9.90301	cos. $(G+\alpha)$	9.77829
tan. δ	7.46373		
g	0.77743	g	0.77743
a	8.14417 = −0.01	a'	0.55582 = +3.59
f	= 13.65		+9.86
$d\alpha$ in seconds of arc	= 32.″14	$d\delta$	= 9.86
	−½ 10.714	α	= 20h 0m 2.142
$d\alpha$ in seconds of time	= 2.142	δ	= 0° 10′ 9.″86

H	132° 07′	i =	0.99588
α	285° 00	cos. δ	9.99999
$H+\alpha$	57° 07	c'	0.79587 = 6.″25
sin. $(H+\alpha)$	9.92416	cos. $(H+\alpha)$	9.73474
sec. δ	0.00001	sin. δ	7.76475
h	1.28870	h	1.28870
b	1.21287 = +16.″33	b'	8.78819 = 0.06
G	6° 53′		
$G+\alpha$	291° 53		
sin. $(G+\alpha)$	9.96752	cos. $(G+\alpha)$	9.57138
tan. δ	7.96476		
g	0.77743	g	0.77743
a	8.50971 = −0.03	a'	0.34881 = 2.23
f	= 13.65		= 8.54
	29.95	$d\delta$	=
$d\alpha$ in seconds of arc	= 29.95	α	= 19h 00m 01.996
	−½ 9.98	δ	= + 0° 20′ 08.″54
$d\alpha$ in seconds of time	= +1.996		

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OBSERVATORY OF HARVARD COLLEGE.

REDUCTION OF ZONES.

ZONE 10 Aug - 12th 1852

[Form, No. 2.]

Sidereal Time = 18h 05m
" = 20 " 35
2 " 30

Barometer = 30.164 in.
" = 30.154
− .010
− 0".02

Att. Thermometer = 68°
" = 68.

Ext. Thermometer = 67°.2
" = 61.7
− 5.5

" + 0.60
− 0.02
2.5 + 0.58
0.232

t = 64.4
65.8
65.8 − t = + 1.4
.072
28
98
.1008

α h. m.	dα s.	dt s.	dα+dt s.	p "	k = p − dα − dt " s
18 " 00	+ 1.777	− 0.000	+ 1.777	+ 1.874	~~+0.394~~ + 0.097
19 " 00	.991	0.017	+ 1.974	+ 1.874	~~+0.197~~ − 0.100
20 " 00	2.142	− 0.034	+ 2.108	+ 1.874	~~+0.063~~ − 0.234

α h. m.	dδ "	dr' "	dδ+dr' "	q "	d = q − dδ − dr' " "
18 " 00	+ 7.01	+ 0.00	+ 7.01	+ 5.00	~~−3.88~~ − 2.01
19 " 00	8.51	0.23	+ 8.74	+ 5.00	~~−5.61~~ 3.74
20 " 00	9.86	+ 0.46	+ 10.32	+ 5.00	~~−7.19~~ −5.32

ds = + 0".10
dr = + 0.30
ds − dr = − 0.20

Change of k for +10′ in Dec. = + 0.001 s.

Change of d for +10′ in Dec. = − 0.04 + 0".20 = + 0".16

α h. m.	δ = ° ′ " k s.	δ = ° ′ " k s.	δ = ° ′ " d "	δ = ° ′ " d "
18 " 00	+ 0.10	.	− 2.0	− 1.9
" 10	.06	.	2.3	2.2
" 20	+ .03	.	2.6	2.4
" 30	− .00	.	2.9	2.7
" 40	.04	.	3.2	3.0
18 " 50	.07	.	3.5	3.3
19 " 00	− 0.10	.	3.7	3.6
" 10	.12	.	4.0	3.8
" 20	.15	.	4.2	4.0
" 30	.17	.	4.5	4.4
" 40	.19	.	4.8	4.7
19 " 50	.21	.	5.0	4.9
20 " 00	− 0.23		− 5.3	− 5.2

The above values of k are corrected for the zero-error of Sept 4 Lines 1852
Mile Zone Book 1853

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1853phae.proj .25

Weiss H 18 No. 353

α 18h 14m 32.02	1825.0	+3.064 = An.p.
1 22.95		27
18 15 54.75	1852.0	21448
		6128
		82728
Dec. +0° 15′ 47.2	1825.0	An.p. +1.27
35.6		sec. var +.05
+0 16 22.8	1852.0	1.32
		27
		924
		64
		35.64

Rümker 6441 Wt. 2

α 18h 15m 05.320	1836.0	An. prec. +3.062
48.992		16
α 18 15 54.312	1852.0	18372
		3062
		48992
Dec. +0° 15′ 57.40	1836.0	An.p. +1.32
21.60		sec. var +.03
Dec. +0 16 19.00	1852.0	1.35
		16
		810
		135
		21.60

Weiss H 18 No. 548

α 18h 21m 40.73	1825.0	An.p. +3.064
1 22.73		
18 23 03.46	1852.0	
Dec. +0° 16′ 13.8	1825.0	An.p. +1.89
52.4		sec. var +.05
+0 17 06.2	1852.0	1.94
		27
		1358
		388
		52.38

Rümker No. 6532 Wt. 3

α 18h 22m 14.182	1836.0	An.p. +3.062
48.992		16
18 23 03.174	1852.0	18372
		3062
		48992
Dec. +0° 16′ 30.78	1836.0	An.p. +1.54
31.52		sec. v. +.03
0 17 02.30	1852.0	1.97
		16
		1182
		197
		31.52

Weisse H 18 No. 1401

α 18h 52m 43.15s	1825.0	An.p. +3.065
1.22.75		27
α 18 55 05.90	1852.0	21455
		6130
		82755
Dec. +0° 12′ 26.5	1825.0	An.p. +4.64
2.07.2		sec. var +.05
0 14 33.7	1852.0	4.71
		27
		3297
		942
		129.17

Weiss H.18 No. 1406

α 18h 53m 53.14	1825.0	
1 22.775		
18 55 15.89	1852.0	
Dec. +0° 16′ 34.″9	1825.0	An.p. +4.67
2.07.2		+.04
+0 18 41.1	1852.0	4.71
		27
		3297
		942
		127.17

Weiss H 19 No. 120

α 19h 04m 20.15	1825.0	An.p. +3.064
1 22.795		27
19 05 42.89	1852.0	21448
		6128
		82728
Dec. +0° 16′ 00.0	1825.0	An.p. +5.56
2.31.2		.04
+0 18.31.2	1852.0	5.60
		27
		3920
		1120
		151.20

Weiss H 19 No. 222

α 19h 08m 15.05s	1825.2	An.p. +3.064
1 22.35		27
19 09 37.40		21350
		6100
		82350
Dec. +0° 11′ 32.0	1825.0	An.p. +5.89
2.40.1		sec. var .04
Dec. +0 14 19.1	1852.0	5.93
		27
		4151
		1186
		160.17

Weisse H 19 No. 718

α 19h 27m 09.52	1825.0	An.p. +3.065
1 22.775		27
19 28 32.27	1852.0	21455
		6130
		82755
Dec. +0° 16′ 26.9	1825.0	An.p. +8.44
3.27.0		sec. v. +.04
Dec. +0 19 48.7	1852.0	8.48
		27
		5236
		1496
		201.96

Weiss 19 No. 789

α 19h 29m 57.36	1825.0	An.p. +3.066
1 22.78		27
α 19 31 14.14	1852.0	21462
		6132
		89782
Dec. +0° 13′ 00.8	1825.0	An.p. +7.66
3.25.2		.05
Dec. +0 16 25.0	1852.0	7.71
		27
		5397
		1542
		208.17

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Zone 10 observed Aug. 12 1852

	f	g	G	h	H	i	
Aug	8 + 13.17	+5.89	8°.10′	+19.55	135°.57′	+5.90	
	13 13.77	6.04	6.34	19.41	131.8	6.34	
	12 +13.65	+5.98	6.53	+19.44	132.06	+6.25	

h m
18.00 = 270°.00
19.00 = 285.00
20.00 = 300.00

$p = (\alpha - t) + (d\alpha + dt)$

No. 16 3 obs.

Weisse 18 No. 353	@ 18h 15m 54.75	s + 0m 16s 22.8
Rümker 6441	@ 18.15 54.31	19.0
	18.15 54.31	19.0
	137	60.8
	@ 18h 15m 54.46	s + 00m 16s 20.3
	t 18.15 54.55	s 0 16 22.
	α − t − 0.09	s − s = − 1.7
	dα + dt + 1.83	ds + dr + 7.4
	p = + 1.74	ds − dr − 0.1
		q = + 5.6

No. 66 1 obs.

Weisse H. 18 No. 1401	@ 18h 55m 05.90	s + 00m 14s 33.7
	t 55 03.55	s 0 14.41
	α − t + 0.35	s − s − 7.3
	dα + dt + 1.95	ds + dr + 8.6
	p = + 2.30	ds − dr − 0.1
		q = + 1.2

No. 84 1 obs.

Weisse H. 19 No. 120	@ 19h 05m 42.89	s + 00m 18s 31.2
	t 19 05 42.35	s 18 34.0
	α − t + 0.54	s − s − 7.8
	dα + dt + 1.90	ds + dr + 8.8
	p + 2.44	ds − dr − 0.2
		q = + 0.8

No. 132 1 obs.

* Weisse H. 19 No. 718	@ 19h 28m 31.77 32.27	s + 00° 19′ 48.7
	t 19 28 31.35	s 0 19 56
	α − t + 0.52	s − s − 7.3
	dα + dt + 2.05	ds + dr + 9.5
	p = + 2.97	ds − dr − 0.2
	p = + 2.47	q = + 7.0

$q = (s - s) + (ds + dr) + (ds - dr)$

No. 22 4 obs.

Weisse H 18 No. 344	@ 18h 23m 03.46	s + 00m 17s 06.2
Rümker 6532	3.17	18 2.3
	3.17	2.3
	3.17	2.3
	97	18.1
	@ 18h 23m 03.24	s + 00m 17s 03.3
	t 18 23 03.30	s 0 17 06.0
	α − t − 0.06	s − s + 2.7
	dα + dt + 1.85	ds + dr + 7.6
	p = + 1.79	ds + dr − 0.1
		q = + 4.8

No. 67 1 obs.

Weisse H 18 No. 1406	@ 18h 55m 15.89	s + 00m 18s 41.1
	t 18 55 15.55	s 0 18 48
	α − t + 0.34	s − s − 6.9
	dα + dt + 1.95	ds + dr + 8.6
	p = + 2.29	ds − dr − 0.2
		q = + 1.5

No. 91 1 obs.

Weisse H. 19 No. 222	@ 19h 09m 37.40	s + 00° 14′ 19.1
	t 19 09 37.75	s 0 14 24
	α − t − 0.35	s − s − 4.9
	dα + dt + 1.99	ds + dr + 9.0
	p = + 1.64	ds − dr − 0.1
		q = + 4.0

No. 136 2 obs.

† Weisse H 19 No. 789	@ 19h 31m 14.14 − 0.25	s + 0m 16s 25.0
	t 0 31 14	s 0 16 33.0
	α − t + 0.14 − 0.25	s − s − 4.0
	dα + dδ + 2.06	ds + dr + 9.2
	p = + 2.20	ds − dr − 0.1
	+ 1.95	q = + 5.1

† Weisses place depends on 2 obs. one of which is in Zone 2 See Note below

* The δ given by Weisse from Zone 1 of Sept has been diminished by 5″.0 as indicated in Zone Book No. 3 Beginning of Book

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p	q
+1.74	5.6
2.30	1.2
2.44	0.8
2.97	2.0
1.79	4.8
2.29	1.5
1.64	4.0
2.20	5.1
8) 17 37	25 0
+ 2.171	+ 3.13

$1^{st}_{\frac{1}{a}}$

p	q
+1.74	+6.6
1.74	5.6
1.74	5.6
1.79	4.8
1.79	4.8
1.79	4.8
1.79	4.8
48	7) 360
1.77 +1.768	+5.14
2.18 2.291	2.81
3.95 4.059	7.95
1.975 p = ~~+2.029~~	q +3.97
p = 1.975	

$2^{nd}_{\frac{1}{2}}$

p	q
+2.30	+1.2
2.44	0.8
2.97	2.0
2.29	1.5
1.64	4.0
2.20	5.1
1.95 2.20	5.1
16.04	7) 197
2.291	+2.81
2.18	

Test of $d\alpha$ & $d\delta$ by δ Aquilæ

Mean	19h 18m 02.048	+ 2m 49s 24.81	
α_1	19h 18m 04.080	2m 49s 34.40	
$d\alpha$	+ 2.032	+ 9.59	
cor for 170'	− 032	51	
$d\alpha$	2.000	$d\delta$	9.08
comp	2.006		8.92

By Catalogue Stars $p = +1.975$ $q = +3.97$

By Zones & q $+1.793$ by $\delta\delta$. $+5.60$

p $+1.874$ $+5.0$

Which value has been adopted

Comparison of Zone 10 with Zones & q.

δ	No in Zone 10	t	s
	1	18m 06m 26.70	− 0m 12.0

By Zones & q

p	q
+ 1.84	+ 6.″2
.87	5.4
.67	7.5
.71	3.3
p = + 1.773	q = + 5.6

No in Zone 10

Zone & q

α	18m 06m 26.78	δ	0° 9′ 47.″0
t	18m 06m 26.70	s	+ 0m 9m 48.0
α − t	+ 0.03	δ − s	− 1.0
	+ 1.81	dδ + dτ	+ 7.2
p =	+ 1.84	ds − dτ	− 0.2
		q =	+ 6.2

19h 41m 03.00 + 0m 9m 42.0

α	18m 48m 12.84	δ = 0	9 34.9
t	18m 48m 12.90	s + 0m 9m	38.0
α − t	− 0.06		− 3.1
	+ 1.93		+ 8.5
p =	+ 1.87		− 0.0
		q	+ 5.4

19h 14m 02.09

19h 14m 02.40 s + 0m 10m 13.0

14m 02.09 δ 10m 07.3

+ 0.31 δ − δ − 5.7

2.02 dδ + dτ + 9.0

p = + 1.71 ds − dτ 0.0

q + 3.3

α	19h 29m 01.98	δ	0m 9m 35.0
t	19h 26m 02.35	s +	0m 9m 37.0
	19h 26m 1.98		− 2.0
α − t	− 0.37		+ 9.5
	+ 2.04	q	+ 7.5
p	+ 1.67		

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OBSERVATORY OF HARVARD COLLEGE.

REDUCTION OF ZONES.

ZONE 11 Aug. 13, 1852

[Form, No. 1.]

H	131° 08′	$\cdot = i \cdot$	
α	270° 00	$\cos\delta$	
$H+\alpha$	41° 08	c'	= 6.34
$\sin.(H+\alpha)$	8.81810	$\cos.(H+\alpha)$	9.87690
$\sec.\delta$	0.00000	$\sin.\delta$	7.46373
$\cdot = h$	1.28803	h	1.28803
b	1.10613 = 12.76	b'	8.62866 = 0.04
G	6° 34′		
$G+\alpha$	276° 34		
$\sin.(G+\alpha)$	9.99714	$\cos.(G+\alpha)$	9.05827
$\tan.\delta$	7.46373		
$\cdot = g$	0.78104	g	0.78104
a	8.24191 = −0.02	a'	9.83931 = 0.69
	f = 13.77		7.07
	26.51	$d\delta$	= +7.07
$d\alpha$ in seconds of arc =	26.51		h m s
	−⅓ 8.837	α =	18° 00 01.767
$d\alpha$ in seconds of time =	s. 1.767	δ =	+0° 10′ 07.07

H	131° 08′	$\cdot = i \cdot$	
α	285° 00	$\cos\delta$	
$H+\alpha$	56° 08	c'	= 6.34
$\sin.(H+\alpha)$	9.91925	$\cos.(H+\alpha)$	9.74606
$\sec.\delta$	0.00000	$\sin.\delta$	7.46373
$\cdot = h$	1.28803	h	1.28803
b	1.20728 = 16.12	b'	8.49782 = 0.03
G	6° 34′		
$G+\alpha$	291° 34		
$\sin.(G+\alpha)$	9.96848	$\cos.(G+\alpha)$	9.56536
$\tan.\delta$	7.46373		
$\cdot = g$	0.78104	g	0.78104
a	8.21325 = −0.02	a'	0.34640 = 2.22
	f = 13.77		8.56
		$d\delta$	= 8.56
$d\alpha$ in seconds of arc =	29.87		h m s
	−⅓ 9.98	α =	19° 00 01.991
$d\alpha$ in seconds of time =	s. 1.991	δ =	+0° 10′ 08.56

H	131° 08′	$\cdot = i \cdot$	
α	300° 00	$\cos\delta$	
$H+\alpha$	71° 08	c'	= 6.34
$\sin.(H+\alpha)$	9.97602	$\cos.(H+\alpha)$	9.50970
$\sec.\delta$	0.00000	$\sin.\delta$	7.46373
$\cdot = h$	1.28803	h	1.28803
b	1.26405 = 18.37	b'	8.26146 = .02
G	6° 34′		
$G+\alpha$	306° 34		
$\sin.(G+\alpha)$	9.90480	$\cos.(G+\alpha)$	9.77607
$\tan.\delta$	7.46373		
$\cdot = g$	0.78104	g	0.78104
a	8.14957 = −0.01	a'	0.55611 = 3.60
	f = 13.77		9.96
		$d\delta$	= 9.96
$d\alpha$ in seconds of arc =	32.13		h m s
	−⅓ 10.710	α =	20° 00 02.142
$d\alpha$ in seconds of time =	s. 2.142	δ =	+0° 10′ 09.96

H	131° 08′	$\cdot = i \cdot$	
α	285° 00	$\cos\delta$	
$H+\alpha$	56° 08	c'	= 6.34
$\sin.(H+\alpha)$	9.91925	$\cos.(H+\alpha)$	9.74606
$\sec.\delta$	0.00001	$\sin.\delta$	7.76475
$\cdot = h$	1.28803	h	1.28803
b	1.20729 = 16.12	b'	8.79884 = 0.06
G	6° 34′		
$G+\alpha$	291° 34		
$\sin.(G+\alpha)$	9.96848	$\cos.(G+\alpha)$	9.56536
$\tan.\delta$	7.76476		
$\cdot = g$	0.78104	g	0.78104
a	8.51428 = −0.03	a'	0.34640 = 2.22
	f = 13.77		8.62
	29.86	$d\delta$	= 8.62
$d\alpha$ in seconds of arc =	29.86		h m s
	−⅓ 9.95	α =	19° 00 01.99
$d\alpha$ in seconds of time =	s. +1.990	δ =	+0° 20′ 08.62

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OBSERVATORY OF HARVARD COLLEGE.

REDUCTION OF ZONES.

ZONE 11 [Form, No. 2.]

Sidereal Time	Barometer	Att. Thermometer	Ext. Thermometer
h. m.	in.	°	°
18 » 32	30.136	72.0	70.0
» = 20 » 32	» = 30.130	" = 70.	" = 66.1
	.006		3.9

α h. m.	dα s.	dt s.	dα+dt s.	p "	k = p − dα − dt "
18 » 00	+1.767	−0.000	+1.767	+2.700	+0.933
19 » 00	+1.991	−0.017	+1.974	2.700	.726
20 » 00	+2.142	−0.034	+2.108	2.700	+0.592

α h. m.	dδ "	dr' "	dδ+dr' "	q "	d = q − dδ − dr' "
18 » 00	+7.07	+0.00	+7.07	+5.04	−2.03
19 » 00	+8.59	+0.21	+8.80	5.04	3.76
20 » 00	+9.96	+0.42	+10.38	+5.04	−5.34

+0,43
dr = +0,42
ds = +0.072(65°.8 − t)
t = 68°.0
65°.8 − t = −2°.2
+.072
44
154
ds = −,1584
dr = +0,30
ds − dr = −0,4884
dδ = +8,59
dδ' = +8,62
dδ − dδ' = −0,03
ds − dr = −0,46
d = (dδ − dδ') − (ds − dr) = +0,43

Change of k for +10′ in Dec. = s. .

Change of d for +10′ in Dec. = +0".43

α h. m.	δ = ° ′ " k s.	δ = ° ′ " k s.	δ = ° ′ " d "	δ = ° ′ " d "
18 » 00	+0.933	.	−2.0	−1.6
» 10	.89	.	2.3	1.9
» 20	.85	.	2.6	2.2
» 30	.82	.	2.9	2.5
» 40	.78	.	3.2	2.8
» 50	.75	.	3.5	3.1
19 » 00	0.73	.	3.8	3.3
» 10	.70	.	4.0	3.6
» 20	.67	.	4.3	3.9
» 30	.65	.	4.5	4.1
» 40	.63	.	4.8	4.3
» 50	.61	.	5.0	4.6
20 » 00	+0.59	.	−5.3	−4.9

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Zone 11 observed Aug. 13, 1852

Aug 13	s	g	q	h	H	ζ	a 18h,00 =	270°,60 δ=+0°.10
" 13	+13.77	+6.04	6".34	+19.41	131°,08	+6".34	a 19h,00	285°,00 δ=+6°.10
							a 20h,00	300°,00 δ=+9°.10

$p=(a-t)+(da+dt)$ $\qquad q=(\delta-s)+(d\delta+dr')+(ds-dr)$

No. 12 3 obs.

Rüm. 6441 Weisse 353

	h m s	° ′ ″
a	18 15 54.46	δ +0 16 20.3
t	18 15 53.75	s +0 16 23
a−t =	+0.71	δ−s = −2.7
da+dt =	+1.81	dδ+dr' = +7.5
p =	+2.52	ds−dr = −0.2
		q = +4.6

No. 17 4 obs.

Rüm. 6532 Weisse 544

	h m s	° ′ ″
a	18 23 03.24	δ +0 17 03.3
t	18 23 02 45	s 0 17 07
a−t =	+0.79	δ−s = −3.7
da+dt =	+1.84	dδ+dr' = +7.8
p =	+2.63	ds−dr = −0.3
		q = +3.8

No. 49 1 obs.

Weisse 1401

	h m s	° ′ ″
a	18 55 06.90	δ +0 14 33.7
t	18 56 04.90	s 0 14 38
a−t =	+1.00	δ−s = −4.3
da+dt	+1.96	dδ+dr' = +8.6
p =	+2.96	ds−dr = −0.2
		q = +4.1

No. 50 1 obs.

Weisse 1406

	h m s	° ′ ″
a	18 55 15.89	δ +00 18 41.1
t	18 55 14,80	s +0 18 33
a−t =	+1.09	δ−s −6.9
da+dt =	+1.96	dδ+dr' = +8.6
p =	+3.05	ds−dr = −0.2
		q = +1.5

No. 61 1 obs.

Weisse 120

	h m s	° ′ ″
a	19 05 42.89	δ +0 18 31.2
t	19 05 41.45	s 0 18 33
a−t =	+1.44	δ−s = −1.8
da+dt =	+1.98	dδ+dr' = +8.9
p =	+3.42	ds−dr −0.3
		q = +6.8

Weisse 222

Taylor 8865	Taylor 8852
19 10 5.16	19 8 45.68
52.16	52.08
19 10 57.32	19 9 37.76
19 10 56.50	9 37.00
0.82	0.76
da+dt 2.00	2.00
+2.82	2.76

1 obs. **No. 65** Taylor

	h m s	° ′ ″	
a	19 09 37.40	δ +0 14 19.1	6 7.44.7
t	19 09 37.00	s 0 14 22	+1 43.2
a−t =	+0.40	δ−s = −2.9	δ 0 9 27.9
da+dt =	+2.00	dδ+dr' + 9.0	s 9 33.0
p =	+2.40	ds−dr −0.2	δ−s −5.1
		q = +6.9	

No. 89 1 obs.

Weisse 718

	h m s	° ′ ″
a	19 28 32.27	δ +0 19 48.7
t	19 28 30.50	s 0 19 58
a−t =	+1.77	δ−s −9.3
da+dt =	+2.01	dδ+dr' +9.5
p =	+3.78	ds−dr −0.4
		q = −.02

No. 92 2 obs.

Weisse 789

	h m s	° ′ ″
a	19 31 14.14	δ +0 16 29.0
t	19 31 13.10	s 0 16 32
a−t =	+1.04	δ−s = −3.0
da+dt =	+2.04	dδ+dr' = +9.6
p =	+3.08	ds−dr −0.3
		q = +6.3

1st ½		2nd ½	
p	q	p	q
+2.52	+4.6	+3.05	+1.5
2.92	4.6	3.42	+6.8
2.62	4.6	2.40	+5.9
2.63	3.8	3.98	−0.2
2.63	3.8	3.08	+6.3
2.63	3.8	3.08	+6.3
2.63	3.8	6) 1881	6) 266
2.96	+4.1	3.135	+4.43
8) 504	331	2.630	4.14
+2.630	+4.14	5.765	57
		p = +2.882	q = +4.28
		p = +2.80	

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Determination of a value of μ from stars in Zone 10

No. 1

Z. 10 No. 1 α 18ʰ 06ᵐ 26ˢ.78 δ +00° 09′ 45″.8
t 18ʰ 6ᵐ 26ˢ.05 s 0ᵐ 9ˢ.46.0
$\alpha - t$ + 0.73 $\delta - s$ − 0.2
$d\alpha + dt$ + 1.78 $d\delta + d\delta'$ + 7.2
μ = + 2.51 $ds - dr$ 0.0
φ = + 7.0

No. 2

Z. 10 No. 2 α 18ʰ 06ᵐ 54ˢ.48 δ + 0° 12′ 26″.8
t 18ʰ 6ᵐ 53ˢ.75 s 0ᵐ 12ˢ.28.0
$\alpha - t$ + 0.73 $\delta - s$ − 1.2
$d\alpha + dt$ + 1.78 $d\delta + d\delta'$ + 7.2
μ = + 2.51 $ds - dr$ − 0.1
φ = + 5.9

No. 4

Z. 10. No. 5 α 18ʰ 08ᵐ 18ˢ.07 δ + 0° 14′ 08″.8
t 18ʰ 8ᵐ 17ˢ.30 s 0ᵐ 14ˢ 11ˢ.0
$\alpha - t$ + 0.77 $\delta - s$ − 2.2
$d\alpha + dt$ + 1.79 $d\delta + d\delta'$ + 7.3
μ = + 2.56 $ds - dr$ − .2
φ = 3.9

No. 44

Z. 10 No. 59 α 18ʰ 51ᵐ 36ˢ.63 δ + 00° 15′ 09″.6
t 18ʰ 51ᵐ 36ˢ.10 s 0ᵐ 15ˢ.11
$\alpha - t$ + 0.53 $\delta - s$ − 1.4
$d\alpha + dt$ + 1.94 $d\delta + d\delta'$ + 8.5
μ = 2.47 $ds - dr$ − 0.2
φ = + 6.9

No. 45

Z. 10 No. 61 α 18ʰ 53ᵐ 12ˢ.52 δ + 0° 11′ 39″.5
t 53ᵐ 12ˢ.15 s 0ᵐ 11ˢ.41
$\alpha - t$ + 0.77 $\delta - s$ − 1.5
$d\alpha + dt$ + 1.95 $d\delta + d\delta'$ + 8.5
μ = + 2.72 $ds - dr$ − 0.0

No. 48

φ = + 7.0

Z. 10 No. 65 α 18ʰ 54ᵐ 33ˢ.47 δ + 00° 10′ 06″.4
t 18ʰ 54ᵐ 32ˢ.90 s 00ᵐ 10ˢ.09
$\alpha - t$ + 0.57 $\delta - s$ − 2.6
$d\alpha + dt$ + 1.96 $d\delta + d\delta'$ + 8.6
μ = + 2.53 $ds - dr$ 0.0
φ = + 6.0

t for Zone 11 — Beginning of Zone

t	α	$\alpha - t$	s	δ	$\delta - s$
18ʰ 06ᵐ 26ˢ.05	26ˢ.78	+ 0ˢ.73	+ 00ᵐ 09ˢ 46ˢ.0	9′ 45″.8	− 0″.2
53.75	54.48	.73	12ᵐ 28ˢ	12ᵐ 26″.4	− 1.2
56.40	57.32	92	10ᵐ 14ˢ	10ᵐ 14″.8	+ 0.8
17.30	18.07	77	14ᵐ 11ˢ	14ᵐ 8″.8	− 2.2
39.50	40.31	81	11ᵐ 12ˢ	11ᵐ 12″.7	+ 0.7
34.05	34.94	89			− 2.1
9.15	9.91	0.76			$d\delta + d\delta'$ + 7.3
~~29.90~~	~~30.91~~	~~+1.00~~			$ds - dr$ − .1
		562			+ 5.1

18ʰ.08ᵐ $\alpha - t$ + 0.803
$d\alpha + dt$ + 1.80
μ = + 2.603

Middle of Zone

t	α	$\alpha - t$	s	δ	$\delta - s$
18ʰ 51ᵐ 36ˢ.10	36ˢ.63	+ 0ˢ.53	+ 0ᵐ 15ˢ.11	0ᵐ 15′ 09″.6	− 1.4
53ᵐ 12ˢ.15	12ˢ.92	.77	11ᵐ.41	11ᵐ 39″.5	− 1.5
31.60	32.17	57	12ᵐ.35	12ᵐ 33.5″	− 1.5
54 8 00	8.57	57	16ᵐ.38	16ᵐ 36.5″	− 1.5
32 50	33.47	57	10ᵐ.09	10ᵐ 6.9	− 2.6
55 4.90	5.46	56			8.5
55 14.80	15.46	66			− 1.7
57ᵐ 2 10	2.76	66			$d\delta + d\delta'$ + 8.5
		8) 4.89			$ds - dr$ − 0.2
					+ 6.6
18ʰ 54ᵐ	$\alpha - t$	0.611			− 7.53
	$d\alpha + dt$	+ 1.9~~55~~			
	μ	= 2.5~~65~~			

End of Zone

t	α	$\alpha - t$	s	δ	$\delta - s$
19ᵐ 35ᵐ 56ˢ.55	57ˢ.07	+ 0ˢ.52	+ 0ᵐ 19ˢ.48	0ᵐ 19′ 44″.5	− 3.5
50.90	51.12	.22	0ᵐ 16ˢ.14	16ᵐ 9″.4	4.6
55.95	56.42	47	14ᵐ.49	14ᵐ 45.5″	3.5
2 55	3.97	42	~~2ᵐ.25~~	~~2ᵐ 15″.4~~	~~9.6~~
22.35	22.77	42	15ᵐ.08	13ᵐ 03.3	4.7
19.10	19.71	61	15ᵐ.05	15ᵐ 02.3	2.7
57.05	57.61	56	20ᵐ.11		− 3.8
41ᵐ 38.15	38.81	46			$d\delta + d\delta'$ + 9.7
19ᵐ.39 $\alpha - t$	0.463	8) 3.70			$ds - dr$ − .2
$d\alpha + dt$	2.092				+ 5.7
μ	= + 2.515	0.463			

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By Comparison with Zone 10

Beginning of Zone	p =	+ 2.603
Middle "		+ 2.565
End "		+ 2.515
	3	7.683
By Zone 10 —	p =	+ 2.561
By Catalogue stars	p =	+ 2.80
Adopted value	p =	+ 2.70

Beginning of Zone	q =	+ 5".1
Middle " " "		6.6
End " " "		5.7
		17.4
By Zone 10 =	q =	+5.80
By Catalogue stars	q =	+4.28
Adopted val.	q =	+5.04

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OBSERVATORY OF HARVARD COLLEGE.

REDUCTION OF ZONES.

ZONE 12

[Form, No. 1.]

H	126° 13′	″ . $= i$.		H	126° 13′	″ . $= i$.	
α	270° 00	cos. δ .		α	285° 00	cos. δ .	
$H+\alpha$	36° 13	c'	$= 6.''75$	$H+\alpha$	51° 13	c'	$= 6.''75$
sin. $(H+\alpha)$	9.77147	cos. $(H+\alpha)$	9.90676	sin. $(H+\alpha)$	9.89183	cos. $(H+\alpha)$	9.79684
″ sec. δ	0.00001	sin. δ	7.76475	″ sec. δ	0.00001	sin. δ	7.76475
″ $= h$	1.28488	h	1.28488	″ $= h$	1.28488	h	1.28488
b	1.05636 $= 11.''39$	b'	8.95639 $= 0.''09$	b	1.17672 $= 15.''02$	b'	8.84647 $= 0.''07$
G	5° 08′			G	5° 08′		
$G+\alpha$	275° 08			$G+\alpha$	290° 08		
sin. $(G+\alpha)$	9.99825	cos. $(G+\alpha)$	8.95170	sin. $(G+\alpha)$	9.972622	cos. $(G+\alpha)$	9.53682
″ tan. δ	7.76476			″ tan. δ	7.76476		
″ $= g$	0.79727	g	0.79727	″ $= g$	0.79727	g	0.79727
a	8.56028 $= -0.''04$	a'	9.74897 $= 0.''56$	a	8.53465 $= -0.''03$	a'	0.33409 $= 2.''16$
	$f = 14.34$		7.40		$f = 14.34$		8.88
	25.69	$d\delta$	= .		29.33	$d\delta$	= .
$d\alpha$ in seconds of arc =	25.69		h m s	$d\alpha$ in seconds of arc =	29.33		h m s
$-\frac{1}{3}$	8.563	α =	18 00 01.713	$-\frac{1}{3}$	9.777	α =	19 00 01.955
$d\alpha$ in seconds of time =	1.''713		° ′ ″	$d\alpha$ in seconds of time =	1.''955		° ′ ″
		$\delta = +0$	20 07.4			$\delta = +0$	20 08.88

H	126° 13′	″ . $= i$.		H	° ′	″ . $= i$.	
α	300° 00	cos. δ .		α	″	cos. δ .	
$H+\alpha$	66° 13	c'	$= 6.''75$	$H+\alpha$	″	c'	$= ''$.
sin. $(H+\alpha)$	9.96146	cos. $(H+\alpha)$	9.60561	sin. $(H+\alpha)$	.	cos. $(H+\alpha)$	.
″ sec. δ	0.00001	sin. δ	7.76475	″ sec. δ	.	sin. δ	.
″ $= h$	1.28488	h	1.28488	″ $= h$	.	h	.
b	1.24635 $= 17.''63$	b'	8.65524 $= 0.''05$	b	. $= ''$.	b'	. $=$.
G	5° 08′			G	° ′ ″		
$G+\alpha$	305° 08			$G+\alpha$	″		
sin. $(G+\alpha)$	9.91266	cos. $(G+\alpha)$	9.76003	sin. $(G+\alpha)$	.	cos. $(G+\alpha)$	.
″ tan. δ	7.76476			″ tan. δ	.		
″ $= g$	0.79727	g	0.79727	″ $= g$	.	g	.
a	8.47469 $= -0.''03$	a'	0.55730 $= 3.''61$	a	. $=$.	a'	. $=$.
	$f = 14.34$		10.41		$f =$.		
		$d\delta$	= .			$d\delta$	= .
$d\alpha$ in seconds of arc =	31.94		h m s	$d\alpha$ in seconds of arc =	.		° ′
$-\frac{1}{3}$	10.647	α =	20 00 02.129	$-\frac{1}{3}$	.	α =	″
$d\alpha$ in seconds of time =	2.''129		° ′ ″	$d\alpha$ in seconds of time =	.		
		$\delta = +0$	20 10.41			$\delta =$	

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OBSERVATORY OF HARVARD COLLEGE.

REDUCTION OF ZONES.

ZONE 12 [Form, No. 2.]

Sidereal Time = h. m. / " Barometer = in. . Att. Thermometer = ° . Ext. Thermometer = ° .
" = " " = . " = . " = .

α h. m.	$d\alpha$ s.	dt s.	$d\alpha + dt$ s.	p "	$k = p - d\alpha - dt$ "
18 » 00	+1·713	.	.	.	.
19 » 00	+1·955	.	.	.	.
20 » 00	+2·179	.	.	.	.

α h. m.	$d\delta$ "	dr' "	$d\delta + dr'$ "	q "	$d = q - d\delta - dr'$ "
18 » 00	+7·40	.	.	.	.
19 » 00	+8·88	.	.	.	.
20 » 00	+10·41	.	.	.	.

Change of k for +10′ in Dec. = s. . Change of d for +10′ in Dec. = " .

	δ = ° ′ / "	δ = ° ′ / "	δ = ° ′ / "	δ = ° ′ / "
α h. m.	k s.	k s.	d "	d "
»	.	.	.	.
»	.	.	.	.
»	.	.	.	.
»	.	.	.	.
»	.	.	.	.
»	.	.	.	.
»	.	.	.	.
»	.	.	.	.
»	.	.	.	.
»	.	.	.	.
»	.	.	.	.
»	.	.	.	.
»	.	.	.	.
»	.	.	.	.

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Zone 12 Observed Aug. 18, 1852

	f	g	g′	h	H	z′	α	δ
Aug. 18	+14.34	+6.27	5°.08′	+19.27	126°.13′	+6.75	18h.00 = 270°.00	δ = +0°.26′
							19h.00 285°.00	0°.20
							20h.00 300°.00	0°.20

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OBSERVATORY OF HARVARD COLLEGE.

REDUCTION OF ZONES.

ZONE 13

[Form, No. 1.]

H	45 ° 47 ′	$= i$	
α	300 ° 00	cos. δ	
$H+\alpha$	345 ° 47	c'	$= +6.05$
sin. $(H+\alpha)$	9.39021	cos. $(H+\alpha)$	
sec. δ	0.00000	sin. δ	∞
$= h$	1.28959	h	
b	0.67980 $= -4.78$	b'	$=$
G	0 ° 17 ′		
$G+\alpha$	300 ° 17		
sin. $(G+\alpha)$	9.93628	cos. $(G+\alpha)$	9.70267
tan. δ	∞		
$= g$		g	0.97772
a	$=$	a'	0.68039 $= 4.79$
	$f = +21.80$		10.84
	17.02	$d\delta$	$= +10.84$
$d\alpha$ in seconds of arc	$= +17.02$		h m
$-\frac{1}{3}$	5.67	α	$= 20\,^{\text{h}}\,00\,^{\text{m}}\,01.134$
$d\alpha$ in seconds of time	$= +1.134$ s.	δ	$= +0\,^{\circ}\,00\,'\,10.84\,''$

H	45 ° 47 ′	$= i$	
α	315 ° 00	cos. δ	
$H+\alpha$	0 ° 47	c'	$= +6.05$
sin. $(H+\alpha)$	8.13581	cos. $(H+\alpha)$	
sec. δ	0.00000	sin. δ	∞
$= h$	1.28959	h	
b	9.42540 $= 0.27$	b'	$=$
G	0 ° 17 ′		
$G+\alpha$	315 ° 17		
sin. $(G+\alpha)$		cos. $(G+\alpha)$	9.85762
tan. δ	∞		
$= g$		g	0.97772
a	$=$	a'	0.82934 $= +6.75$
	$f = +21.80$		12.80
	22.07	$d\delta$	$= +12.80$
$d\alpha$ in seconds of arc	$= 22.07$		h m s
$-\frac{1}{3}$	7.36	α	$= 21\,^{\text{h}}\,00\,^{\text{m}}\,01.478$
$d\alpha$ in seconds of time	$= 1.472$ s.	δ	$= +00\,^{\circ}\,00\,'\,12.80\,''$

H	45 ° 47 ′	$= i$	
α	330 ° 00	cos. δ	
$H+\alpha$	15 ° 47	c'	$= +6.05$
sin. $(H+\alpha)$	9.43457	cos. $(H+\alpha)$	
sec. δ	0.00000	sin. δ	∞
$= h$	1.28959	h	
b	0.72416 $= 5.29$	b'	$=$
G	0 ° 17 ′		
$G+\alpha$	330 ° 17		
sin. $(G+\alpha)$		cos. $(G+\alpha)$	9.93876
tan. δ	∞		
$= g$		g	0.97772
a	$=$	a'	0.91648 $= +8.25$
	$f = +21.80$		14.30
		$d\delta$	$= +14.30$
$d\alpha$ in seconds of arc	$= 27.09$		h m s
$-\frac{1}{3}$	9.03	α	$= 22\,^{\text{h}}\,00\,^{\text{m}}\,01.806$
$d\alpha$ in seconds of time	$= 1.806$ s.	δ	$= +00\,^{\circ}\,00\,'\,14.30\,''$

H	45 ° 47 ′	$= i$	0.78176
α	315 ° 00	cos. δ	0.00000
$H+\alpha$	0 ° 47	c'	$= +6.05$
sin. $(H+\alpha)$	8.13581	cos. $(H+\alpha)$	9.99996
sec. δ	0.00000	sin. δ	7.46373
$= h$	1.28959	h	1.28959
b	9.42540 $= +0.27$	b'	8.75328 $= +0.06$
G	0 ° 17 ′		
$G+\alpha$	315 ° 17		
sin. $(G+\alpha)$	9.84733	cos. $(G+\alpha)$	9.85162
tan. δ	7.46373		
$= g$	0.97772	g	0.97772
a	8.28878 $= -0.02$	a'	0.82934 $= +6.75$
	$f = +21.80$		$+12.86$
	$+22.05$	$d\delta$	$=$
$d\alpha$ in seconds of arc	$= +22.05$		° ′
$-\frac{1}{3}$	7.35	α	$= 21\,''$
$d\alpha$ in seconds of time	$=$ s.	δ	$=$

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OBSERVATORY OF HARVARD COLLEGE.

REDUCTION OF ZONES.

ZONE 13 Nov. 3rd 1852

[Form, No. 2.]

Sidereal Time = 22h 20m	Barometer = 29.906 in.	Att. Thermometer = 68.0°	Ext. Thermometer = 49.0°
" = 0h 50m	" = 29.940	" = 66.0	" = 45.6
2.30	.034		3.4

+0.38
+0.06
dr = +0.44 in 2.30 h m

α h. m.	dα s.	dt s.	dα+dt s.	p "	k = p − dα − dt "
20h 00m	+1.134	+0.000	+1.134	.	.
21h 00m	+1.472	+0.016	+1.488	.	.
22h 00m	+1.806	+0.032	+1.838	.	.

dδ 12.80
dδ' 12.86
dδ − dδ' −0.06
ds +1.24
dr' + dr = +0.38
ds − dr 0.86
+0.86
d = −0.92

α h. m.	dδ "	dr' "	dδ+dr' "	q "	d = q − dδ − dr' "
20h 00m	+10.84	+0.00	+10.84	.	.
21h 00m	+12.80	+0.18	+12.98	.	.
22h 00m	+14.30	+0.36	+14.66	.	.

ds =
*dr = +0.34

*Change of k for +10′ in Dec. = +0.022 s.

Change of d for +10′ in Dec. = −0.92 "

δ = ° ′	δ = ° ′	δ = ° ′	δ = ° ′
"	"	"	"

α h. m.	k s.	k s.	d "	d "
"	.	.	.	.
"	.	.	.	.
"	.	.	.	.
"	.	.	.	.
"	.	.	.	.
"	.	.	.	.
"	.	.	.	.
"	.	.	.	.
"	.	.	.	.
"	.	.	.	.
"	.	.	.	.
"	.	.	.	.
"	.	.	.	.

*The changes of k and of d are corrected for refraction at the hour angle 2h 34m west.

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Test of $d\alpha$ $d\delta$

α Aquarii

Mean	α	$21^h\,58^m\,10.755^s$	δ $-1^\circ\,02'\,13.13''$
App.	Δk	$58^m\,12.56^s$	D -1 $1^\circ\,59'.2$
	$d\alpha$	$+1.805^s$	$d\delta$ $+13.93''$

13.93
14.35
42

$\frac{d.d\delta}{dD} = -\frac{0.''42}{42} = -0.''07$

Change of $d\delta$ for $10'$ in Dec $= -0.''07$

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Zone 13

Observed Nov. 3, 1852

	f	g	G	h	H	i	h m	° ′
Nov.	1	+21.56	+9.39	0..09′	+19.44	47..48′	+6.25	20,,00	=300..00
"	6	22..17	+9.66	0..28	+19.59	42..46	+5.77	21,,00	315..00
Nov.	3	+21.80	+9.50	0..17	+19.48	45..47	+6.05	22,,00	330..00

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OBSERVATORY OF HARVARD COLLEGE.

REDUCTION OF ZONES.

ZONE 14

[Form, No. 1.]

H	44° 47′	$\cdot = i$	$\cdot$
α	300″	cos. δ	$\cdot$
$H+\alpha$	344° 47′	c'	$= +5''.96$
sin. $(H+\alpha)$	$9^{n}.41908$	cos. $(H+\alpha)$	$\cdot$
sec. δ	0.00000	sin. δ	$\cdot \infty$
$\cdot = h$	1.29070	h	$\cdot$
b	$0^{n}.70978 = -5''.13$	b'	$\cdot = \cdot$
G	0° 20′		
$G+\alpha$	300° 20′		
sin. $(G+\alpha)$	$\cdot$	cos. $(G+\alpha)$	9.70332
tan. δ	$\cdot \infty$		
$\cdot = g$	$\cdot$	g	0.98000
a	$\cdot = \cdot$	a'	$0.68332 = 4''.82$
	$f = +21''.93$		$+10''.78$
	$16''.80$	$d\delta$	$= +10''.78$
$d\alpha$ in seconds of arc =	16.80		h m s
$-\frac{1}{3}$	5.60	α =	20° 00′ 01.120
$d\alpha$ in seconds of time =	$+1^{s}.120$	δ =	$+0° 00′ 10''.78$

H	44° 47′	$\cdot = i$	$\cdot$
α	315″	cos. δ	$\cdot$
$H+\alpha$	359° 47′	c'	$= +5''.96$
sin. $(H+\alpha)$	$7^{n}.57767$	cos. $(H+\alpha)$	$\cdot$
sec. δ	0.00000	sin. δ	$\cdot \infty$
$\cdot = h$	1.29070	h	$\cdot$
b	$8^{n}.86837 = -0''.07$	b'	$\cdot = \cdot$
G	0° 20′		
$G+\alpha$	315° 20′		
sin. $(G+\alpha)$	$\cdot$	cos. $(G+\alpha)$	9.85200
tan. δ	$\cdot \infty$		
$\cdot = g$	$\cdot$	g	0.98000
a	$\cdot = \cdot$	a'	$0.83200 = +6''.79$
	$f = 21.93$		$+12.75$
	21.86	$d\delta$	$= +12''.75$
$d\alpha$ in seconds of arc =	+21.86		h m s
$-\frac{1}{3}$	7.29	α =	21° 00′ 01.458
$d\alpha$ in seconds of time =	$+1^{s}.458$	δ =	$+0° 00′ 12''.75$

H	44° 47′	$\cdot = i$	$\cdot$
α	330″	cos. δ	$\cdot$
$H+\alpha$	14° 47′	c'	$= 6''.96$
sin. $(H+\alpha)$	9.40682	cos. $(H+\alpha)$	$\cdot$
sec. δ	0.00000	sin. δ	$\cdot \infty$
$\cdot = h$	1.29070	h	$\cdot$
b	$0.69752 = 4''.98$	b'	$\cdot = \cdot$
G	0° 20′		
$G+\alpha$	330° 20′		
sin. $(G+\alpha)$	$\cdot$	cos. $(G+\alpha)$	9.93898
tan. δ	$\cdot \infty$		
$\cdot = g$	$\cdot$	g	0.98000
a	$\cdot = \cdot$	a'	$0.91898 = 8''.30$
	$f = +21.93$		$+14''.26$
		$d\delta$	$= 14''.26$
$d\alpha$ in seconds of arc =	26.91		h m s
$-\frac{1}{3}$	8.97	α =	22° 00′ 01.794
$d\alpha$ in seconds of time =	$+1^{s}.794$	δ =	$+0° 00′ 14''.26$

H	44° 47′	$\cdot = i$	$\cdot$
α	315″	cos. δ	$\cdot$
$H+\alpha$	359° 47′	c'	$= 5''.96$
sin. $(H+\alpha)$	$7^{n}.57767$	cos. $(H+\alpha)$	0.00000
sec. δ	0.00000	sin. δ	7.46373
$\cdot = h$	1.29070	h	1.29070
b	$8^{n}.86837 = -0''.07$	b'	$8.75443 = 0''.06$
G	0° 20′		
$G+\alpha$	315° 20′		
sin. $(G+\alpha)$	$9^{n}.84694$	cos. $(G+\alpha)$	9.85200
tan. δ	7.46373		
$\cdot = g$	0.98000	g	0.98000
a	$8.29067 = -0''.02$	a'	$0.83200 = 6''.79$
	$f = 21.93$	$d\delta$	$+12''.81$
	21.84	$d\delta$	$= \cdot$
$d\alpha$ in seconds of arc =	+21.84		° ′
$-\frac{1}{3}$	7.28	α =	″
$d\alpha$ in seconds of time =	1.454	δ =	

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OBSERVATORY OF HARVARD COLLEGE.

REDUCTION OF ZONES.

ZONE 14 Nov. 4th 1852 - [Form, No. 2.]

Sidereal Time	Barometer	Att. Thermometer	Ext. Thermometer
h. m.	in.	°	°
21 07	30.048	66.0	43.0
23 08	30.036	64.0	40.6
2 01	.012		2.4

+.27
−.02
+0.25

α h. m.	dα s.	dt s.	dα+dt s.	p s.	k = p − dα − dt s.	s.
20 00	+1.120	+0.000	+1.120	+~~1.645~~ 1.145	~~+0.525~~	+0.025
21 00	+1.458	+0.016	+1.474	~~1.645~~ 1.145	~~+0.171~~	−.329
22 00	+1.794	+0.032	+1.826	~~1.645~~ 1.145	~~−0.181~~	−0.681

t = 41.8
65.8
65.8 − t = +24.0
+.072
480
1680
ds = +1.7280

α h. m.	dδ "	dr' "	dδ+dr' "	q "	d = q − dδ − dr' "
20 00	+10.78	+0.00	+10.78	+3.50	−7.28
21 00	+12.75	+0.12	+12.87	+3.50	−9.37
22 00	+14.26	+0.25	+14.51	+3.50	−11.01

dδ = +12.75
dδ₁ = +12.81
dδ − dδ₁ = −0.06

corr for triangle
ds = +1.73
dr = +0.32 + 0.02
ds + dr = +~~1.75~~ +1.43

Change of k for +10′ in Dec. = +0.015 (including fraction) Change of d for +10′ in Dec. = −0.06 − 1.43 = −1.49

δ = 0° 00′ δ = +0° 10′ δ = 0° 00′ δ = +0° 10′

α h. m.	k s.	✳	k s.	✳	d "	d "
20 00	+0.52	+0.02	+0.~~54~~	+0.04	−7.3	−8.8
10	.47	−.03	.48	−.02	7.7	9.2
20	.40	.09	.42	.08	8.0	9.5
30	.35	.15	.36	.14	8.4	9.9
40	.25	.21	.30	20	8.7	10.2
50	.23	.27	.24	.26	9.1	10.6
21 00	+0.17	.33	.19	.31	−9.4	10.9
10	.11	.39	.13	.37	9.7	11.2
20	+0.05	.45	+0.07	.43	10.0	10.5
30	.00	50	+0.02	.48	10.2	11.7
40	−0.06	56	−.04	.54	10.5	12.0
50	.12	62	.10	.60	10.7	12.2
22 00	−0.18	−0.68	+0.16	−066	−11.0	−12.5

The new values I have corrected for the Error of Dec. Long 1852 — Dec 25 for

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Nov. 4, 1852

Test of d α γ δ
α Aquarii.

Mean α 21h 58m 10.757 — δ −1° 02′ 13.13
R 21h 58m 12.55 — D 1″ 59.2
1.793 — 13.93

W H XIX 1270

R 19h 49m 05.26 1825.0 — Ann. pr. +3.069 — 27 — 21486 — 6138 — +82866
+1m 22.87
19h 50m 28.13 − 1852.0

δ +0° 02′ 35.3 1825.0 — Ann. p. +9.19 — sec. var. +.05 — +9.24 — 27 — 6468 — 1848 — 24948
9° 09.48
0° 06′ 44.8 − 1852.0

W. H. XIX 1288

R 19h 49m 53.39 − 1825.0 — Ann. p. +3.069 — 27 — 21483 — 6138 — 82863
1m 22.86
19h 51m 16.25 − 1852.0

δ +0° 03′ 53.3 − 1825.0 — Ann. p. +9.25 — sec. var. +.05 — 9.30 — 27 — 6510 — 1860 — 25110
+4′ 11.1
δ +0° 08′ 06.4 1852.0

W. XIX 1456

R 19h 56m 23.83 1825.0 — Ann. p. +3.071 — 27 — 21497 — 6142 — 82917
+1m 22.92
19h 57m 46.65 1852.0

δ −0° 02′ 09.9 1825.0 — Ann. p. +9.75 — sec. var. +.05 — 9.80 — 27 — 6860 — 1960 — 26460
+4′ 24.6
δ +0° 02′ 14.7 1852.0

W XX 250

R 20h 08m 07.05 1825.0 — Ann. p. +3.071
1m 22.82
20h 09m 29.97 − 1852.0

δ −0° 02′ 37.0 1825.0 — Ann. p. +10.64 — sec. var. +.04 — 10.68 — 27 — 7476 — 2136 — 28836
+4′ 48.4
+0° 02′ 11.4 1852.0

W. XX 269

R 20h 10m 01.89 1825.0 — Ann. p. +3.069 — 27 — 21483 — 6138 — 82863
1m 22.86
R 20h 11m 24.75 1852.0

δ +0° 03′ 29.2 1825.0 — Ann. p. +10.78 — sec. var. +.04 — 10.82 — 27 — 7574 — 2164 — 29214
+4′ 52.1
δ +0° 08′ 21.3 1852.0

W H XX 1479

R 20h 56m 23.52 1825.0 — Ann. p. +3.070 — 27 — 21490 — 6140 — 82890
1m 22.89
20h 57m 46.41 − 1852.0

δ +0° 02′ 08.6 1826.0 — Ann. p. +13.96 — sec. var. +.04 — +13.99 — 27 — 9793 — 2798 — +377.73

W. H. XX 1490

R 20h 56m 54.31 1825.0 — Ann. pr. +3.070 — 27 — 21490 — 6140 — 82890
1m 22.89
20h 58m 17.20 1852.0

δ −0° 02′ 02.4 1825.0 — Ann. pr. +13.99 — +.04 — 14.03 — 27 — 9871 — 2806 — 378.81
+6′ 18.8
δ +0° 04′ 16.4 1852.0

W. H. XXI 64

R 21h 02m 42.55 1825.0 — Ann. pr. +3.070
1m 22.89
21h 04m 05.44 − 1852.0

δ −0° 01′ 51.9 1825.0 — Ann. pr. +14.35 — sec. var. +.04 — 14.39 — 27 — 10093 — 2878 — 388.53
+6′ 28.5
δ +0° 04′ 36.6 − 1852.0

W H XXI 303

R 21h 12m 05.95 1825.0 — Ann. p. +3.071 — 27 — 21497 — 6142 — 82917
+1m 22.92
21h 13m 28.87 1852.0

δ +0° 03′ 34.7 1825.0 — Ann. p. +14.91 — s. v. +.04 — 14.95 — 27 — 10465 — 2960 — 403.65
+6′ 43.6
δ +0° 08′ 19 − 1852.0

Santini 1483

R 21h 12m 51.53 1840.0 — Ann. p. +3.070 — 12 — 6140 — 36840
+36.84
21h 13m 28.37 − 1852.0

δ +0° 00′ 04.1 1840.0 — Ann. p. +14.95 — s. var. +.02 — 14.97 — 12 — 2994 — 1497 — 179.64
2h 59.6
δ +0° 03′ 03.7 1852.0

W. H. XXI 379

R 21h 15m 18.80 1825.0 — Ann. p. +3.072 — 27 — 21504 — 6144 — 82949
1m 22.94
21h 16m 41.74 1852.0

δ −0° 07′ 03.0 1825.0 — Ann. p. +15.10 — +.04 — 15.14 — 27 — 10998 — 3028 — 408.78
+6′ 48.9
δ −0° 00′ 14.1 1852.0

W. H. XXI 951

R 21h 37m 57.73 1825.0 — Ann. p. +3.070 — 27 — 21490 — 6140 — 82890
1m 22.89
21h 39m 20.62 1852.0

δ +0° 02′ 57.90 1825.0 — Ann. p. +16.33 — s. v. +.04 — 16.37 — 27 — 11959 — 3274 — 441.99
+7′ 22.6
+0° 10′ 19.9 1852.0

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Zone 14

Observed Nov. 4, 1852

	f	g	G	h	H_0	i	h m	° ′
Nov. 1	+21″.56	+9.39	00..09	+19.44	47..48	+6″.25	20..00	300..00
" 6	22.17	+9.66	0..28	+19.59	42..46	+5.77	21..00	315..00
Nov. 4	+21.93	+9.55	0..20	+19.53	44..47	+5.96	22..00	330..00

$p = (\alpha - t) + (d\alpha + dt)$ $\qquad q = (\delta - s) + (d\delta + d\tau') + (ds - d\tau)$

No. 5 2 obs.

Weisse H.XIX 1270 α 19h 50m 28.13 δ = +0° 06′ 44.8

t 50 27.65 s 6.56

$\alpha - t$ = +0.48 $\delta - s$ = −11.2

$d\alpha + dt$ = +1.06 $d\delta + d\tau'$ + 10.4

p = +1.54 $ds - d\tau$ + 0.8

Corr for B.Z. 1 & 2 −0.50

p = +1.04 q = + 0,0

No. 6 2 obs.

Weisse H.XIX 1288 α = 19h 51m 16.25 δ +0° 04′ 06.4

t 19 51 15.75 s 0 08.16

$\alpha - t$ +0,50 $\delta - s$ −09.6

$d\alpha + dt$ +1.07 $d\delta + d\tau'$ + 10.4

p = +1.57 $ds - d\tau$ + 1.1

Corr B.Z. 1 & 2 −0.50

+1.07 q = +1,9

No. 14 2 obs.

Weisse H.XIX 1456 α 19h 57m 46.65 δ = +0° 02′ 14.7

t 57 46.20 s 0, 2.24

$\alpha - t$ +0.45 $\delta - s$ − 9,3

$d\alpha + dt$ +1.11 $d\delta + d\tau'$ +10.7

p = +1.56 $ds - d\tau$ + 0.3

−.50 q = + 1.7

+1.06

No. 32 1 obs.

Weisse XX 220 α 20h 09m 29.97 δ + 0° 02′ 11.4

t 9 29.70 s 2.15

$\alpha - t$ +0.27 $\delta - s$ − 3.6

$d\alpha + dt$ + 1.17 $d\delta + d\tau'$ + 11.0

p = +1.44 $ds - d\tau$ + .3

−0.50 q = + 7.7

p = + 0.94

No. 33 2 obs.

Weisse XX 269 α 20h 11m 24.75 δ + 0° 08′ 21.3

t 20 11 24.40 s 0 08.31

$\alpha - t$ + 0.35 $\delta - s$ − 9.7

$d\alpha + dt$ + 1.18 $d\delta + d\tau'$ + 11.2

p = +1.53 $ds - d\tau$ + 1.1

−.50 q = + 2.6

p = +1.03

No. 104 2 obs.

Weisse H XX 1479 α 20h 57m 46.41 δ + 0° 08′ 26.3

t 20 57 45.90 s 0, 08.37

$\alpha - t$ + 0,51 $\delta - s$ − 10.7

$d\alpha + dt$ + 1.45 $d\delta + d\tau'$ + 12.8

p = 1.96 $ds - d\tau$ + 1.1

−0.50 q = + 3.2

p = +1.46

No. 106 2 obs.

Weisse H XX 1490 α 20h 58m 17.20 δ + 0° 04′ 16.4

t 20 58 16.60 s 0 04.20

$\alpha - t$ + .60 $\delta - s$ − 3.6

$d\alpha + dt$ + 1.45 $d\delta + d\tau'$ + 12.8

p = + 2.05 $ds - d\tau$ + 0.6

−0.50 q = + 9.8

p = +1.55

No. 118 1 obs.

Weisse H XXI 64 α 21h 04m 05.44 δ + 0° 04′ 36.6

t 21 04 05.55 s 4.44

$\alpha - t$ − 0.11 $\delta - s$ − 7.4

$d\alpha + dt$ + 1.50 $d\delta + d\tau'$ + 13.0

p = + 1.39 $ds - d\tau$ + 0.6

−0.50 q = + 6,2

p = + 0.89

No. 135 4 obs.

Weisse H XXI 303 α 21h 13m 28.87 δ + 0° 03′ 08.9

Santini 1483 α 21h 13m 28.37 03 03.7

124 11.6

α 21h 13m 28.62 δ + 0° 03′ 05.8

t 13 28.65 s 0 03.16

$\alpha - t$ − .03 $\delta - s$ − 10.2

$d\alpha + dt$ + 1.55 $d\delta + d\tau'$ + 13.2

p = + 1.52 $ds - d\tau$ + 0.5

Correction −0.25 q = + 3.5

p + 1.27

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No. 140 1 Sty

Weisse H.XXI.379 α 21h 16m 41.74 δ − 0° 00′ 14.1

See Note in Weisse

t 21h 16m 41.80 s − 0.07

$\alpha - t$ −0.06 $\delta - s$ + 7.1

$d\alpha + dt$ + 1.57 $d\delta + d\pi'$ + 13.4

p = + 1.51 $ds - d\pi$ 6.0

qf = + 6.3

No. 177 3 Sty

Weisse H.XXI 951 α 21h 39m 20.62 δ + 0° 10′ 19.9

t 21h 39m 20.50 s 10.33

$\alpha - t$ +0.12 $\delta - s$ = − 13.1

$d\alpha + dt$ + 1.71 $d\delta + d\pi'$ + 14.9

p = + 1.83 $ds - d\pi$ + 1.4

$\frac{2}{3}$ 0.50 = −0.33

qf = + 2.3

+ 1.50

	1st half	2nd half
p =	+ 1.s04	+ 1.55
	1.07	0.89
	1.06	1.27
	0.94	1.0:
	1.03	1.50
	1.46	
	60	1.22
	1.10	1.24
		1.10
By Catalogue Stars		p = + 1.s17
By Zone 9		p = + 1.12
Final value of p		= + 1.145

Value of p after Correction of Pr. Zone 14 −

The previous reduction of Zone 14 gave the following constant differences

Zone 9 − Zone 14

19h 48m	− 0.66
	.49
	50
	59
	62
	43
	− 37

Mean −0.523 = $z_9 - z_{14}$

= ~~$p_9 - p_{14}$~~

$z_9 - z_{14}$ is the correction of the value of p used in the previous reduction of Zone 14 to give p as it would be derived taking Zone 9 as a standard

Used in previous reduction p = + 1.645

$z_9 - z_{14}$ = −0.523

From Zone 9 p = + 1.122

p	qf
1.s54	0.04
1.54	.00
1.57	1.9
1.57	1.9
1.56	1.7
1.56	1.7
1.44	7.9
1.53	2.6
1.53	2.6
1.96	3.2
1.96	3.2
11) 17.76	11) 26.5
+ 1.61	+ 2.4
2.05	9.8
2.05	9.8
1.35	6.2
1.52	3.5
1.52	3.5
1.52	3.5
1.51	6.3
1.83	2.3
1.83	2.3
1.83	2.3
11) 18.53	11) 53.0
Last half of Zone 1.68	4.6
First half of Zone 1.61	2.4
9	70
p = + 1.645	qf = + 3.5

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REDUCTION OF ZONES.

ZONE 15 Observed Nov. 11, 1852

[Form, No. 1.]

H	37° 47′	$=i$	
α	300°	cos. δ	
$H+\alpha$	337° 47′	c'	$=+5.25$
sin. $(H+\alpha)$	9.57762	cos. $(H+\alpha)$	9.96650
sec. δ	0.00000	sin. δ	7.46373
$=h$	1.29513	h	1.29513
b	0.87275 $=-7.46$	b'	8.72536 $=+0.05$
G	0° 45′		
$G+\alpha$	300° 45′		
sin. $(G+\alpha)$	9.93420	cos. $(G+\alpha)$	9.70867
tan. δ	7.46373		
$=g$	0.99739	g	0.99739
a	8.39532 $=-0.02$	a'	0.70606 $=+5.08$
	$f=+22.82$		$+10.38$
	$+15.34$	$d\delta$	$=$
$d\alpha$ in seconds of arc $=$	15.34		h m s
$-\frac{1}{9}$	6.11	$\alpha=$	20° 00′ 01.022
$d\alpha$ in seconds of time $=$	s. $+1.022$	$\delta=$	$+0°\ 10′\ 10.38″$

H	37° 47′	$=i$	0.72016
α	315°	cos. δ	0.00000
$H+\alpha$	352° 47′	c'	0.72016 $=+5.25$
sin. $(H+\alpha)$	9.09907	cos. $(H+\alpha)$	9.99655
sec. δ	0.00006	sin. δ	7.46373
$=h$	1.29513	h	1.29513
b	0.39420 $=-2.48$	b'	8.75541 $=+0.06$
G	315° 45′		
$G+\alpha$			
sin. $(G+\alpha)$	9.84373	cos. $(G+\alpha)$	9.85510
tan. δ	7.46373		
$=g$	0.99739	g	0.99739
a	8.30885 $=-0.0$	a'	0.85249 $=+7.12$
	$f=+22.82$		12.43
	$+20.32$	$d\delta$	$=$
$d\alpha$ in seconds of arc $=$	20.32		h m s
$-\frac{1}{9}$	6.77	$\alpha=$	21° 00′ 01.358
$d\alpha$ in seconds of time $=$	s. 1.354	$\delta=$	$+0°\ 10′\ 12.43″$

H	37° 47′	$=i$	
α	330°	cos. δ	
$H+\alpha$	7° 47′	c'	$=+5.25$
sin. $(H+\alpha)$	9.13171	cos. $(H+\alpha)$	9.99598
sec. δ	0.00006	sin. δ	7.46373
$=h$	1.29513	h	1.29513
b	0.42684 $=+2.67$	b'	8.75484 $=0.06$
G	330° 45′		
$G+\alpha$			
sin. $(G+\alpha)$	9.68897	cos. $(G+\alpha)$	9.94076
tan. δ	7.46373		
$=g$	0.99739	g	0.99739
a	8.15009 $=-0.01$	a'	0.93815 $=+8.67$
	$f=+22.82$		13.96
	$+25.48$	$d\delta$	$=$
$d\alpha$ in seconds of arc $=$	25.48		h m
$-\frac{1}{9}$	8.49	$\alpha=$	22° 00′ 01.698
$d\alpha$ in seconds of time $=$	s. 1.698	$\delta=$	$+0°\ 10′\ 13.96″$

H	37° 47′	$=i$	
α	315°	cos. δ	
$H+\alpha$	352° 47′	c'	$=+5.25$
sin. $(H+\alpha)$	9.09907	cos. $(H+\alpha)$	9.99655
sec. δ	0.00000	sin. δ	7.46373
$=h$	1.29513	h	1.29513
b	0.39420 $=-2.49$	b'	9.06643 $=+0.11$
G	0° 45′		
$G+\alpha$	315° 45′		
sin. $(G+\alpha)$	9.84373	cos. $(G+\alpha)$	9.85520
tan. δ	9.76426		
$=g$	0.99739	g	0.99739
a	8.60588 $=-0.04$	a'	0.85249 $=+7.12$
	$f=+22.82$		12.48
	$+20.29$	$d\delta$	$=$
$d\alpha$ in seconds of arc $=$	$+20.29$		° ′
$-\frac{1}{9}$	6.76	$\alpha=$	″
$d\alpha$ in seconds of time $=$	s. 1.352	$\delta=$	

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REDUCTION OF ZONES.

ZONE 15

[Form, No. 2.]

Sidereal Time	Barometer	Att. Thermometer	Ext. Thermometer
h. m.	in.	°	°
21 36	30.248	64.0	39.0
= 23 30	= 30.236	= 65.0	= 35.0
	.012		4.0

α	dα	dt	dα+dt	p	k = p − dα − dt
h. m.	s.	s.	s.	"	"
20 00	+1.022	+0.000	+1.022	+0.579	−0.443
21 00	1.354	+0.033	+1.387	+0.579	−0.808
22 00	1.698	+0.066	+1.764	+0.579	−1.185

α	dδ	dr'	dδ+dr'	q	d = q − dδ − dr'
h. m.	"	"	"	"	"
20 00	+10.38	+0.00	+10.38	+6.11	−4.27
21 00	+12.43	+0.21	+12.64	+6.11	−6.53
22 00	+13.98	+0.42	+14.40	+6.11	−8.29

cor. of k for refraction +0.018
dα' −0.002
0.016

Change of k for +10′ in Dec. = +0.016 s.

Change of d for +10′ in Dec. = −1.80 "

+0.44
−0.02
dr' = +0.42

ds = +0.072 (65.8 − t)
t = 39.0
65.8 − t = +28.8
+.072
576
2016
ds = +2.0736
dr = +0.30
ds − dr = +1.75

dδ +12.48
dδ' +12.48
dδ − dδ' = −0.05
ds − dr = +1.75
d = (dδ − dδ') − (ds − dr) = −1.80

	δ = ° ′	δ = ° ′	δ = + 0° 10′	δ = + 0° 20′
α	k	k	d	d
h. m.	s.	s.	"	"
20 00	−0.44	−0.43	−4.3	−6.1
10	.50	.49	4.7	6.5
20	.56	.55	5.1	6.9
30	.62	.61	5.5	7.3
40	.69	.67	5.8	7.6
50	.75	.73	6.2	8.0
21 00	.81	.79	6.5	8.3
10	.87	.85	6.9	8.7
20	.93	.92	7.2	9.0
30	.99	.98	7.5	9.3
40	1.06	1.04	7.8	9.6
50	1.12	1.10	8.1	9.9
22 00	1.18	1.17	−8.3	−10.1

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Weisse H XIX 1297

AR 19h 50m 09.91 1825.0 Am. p. +3.066
1.22.78
19 51 32.69 1852.0

δ +0° 12' 12.4 1825.0 Am. p. +9.27
4.11.6 sec. v. +.05
δ +0 16 24.0 1852.0

Weisse H XIX 1313

AR 19h 51m 01.64 1825.0 Am. p. +3.067
1.22.81
19 52 24.45 1852.0

δ +0° 10' 38.9 1825.0 Am. p. +9.34
4.13.5 s. var. +.05
δ +0 14 52.4 1852.0

Weisse H XIX 1400

AR 19h 54m 17.83 1825.0 Am. p. +3.066
1.22.78
19 55 40.61 1852.0

δ +0° 13' 05.6 1825.0 Am. p. +9.59
4.20.3 sec. v. +0.05
δ +0 17 25.9 1852.0

Weisse H XX 144

AR 20h 05m 19.90 1825.0 Am. p. +3.066
1.22.78
20 06 42.68 1852.0

δ +0° 12' 37.9 1825.0 Am. p. +10.43
4.43.0 s. v. +.05
δ +0 17 20.9 1852.0

Weisse H XX 256

AR 20 09 40.65 1825.0 Am. p. +3.068
1.22.82
AR 20 11 03.49 1852.0

δ +0 06 40.1 1825.0 Am. p. +10.75
4.31.3 s. v. .04
δ +0 11 61.4 1852.0

Weisse H XX 258

AR 20h 09m 44.42 1825.0 Am. p. +3.067
1.22.81
20 11 07.23 1852.0

δ +0° 10' 55.5 1825.0 Am. p. +10.76
4.51.6 sec. var. .04
δ +0 15 47.1 1852.0

Weisse H XX 304

AR 20h 11m 17.84 1825.0 Am. p. +3.066
1.22.78
AR 20 12 40.62 1852.0

δ +0° 11' 57.0 1825.0 Am. p. +10.87
4.54.6 s. var. +.04
δ +0 16 51.6 1852.0

Weisse H XX 1340

AR 20h 50m 37.06 1825.0 Am. p. +3.067
1.22.81
AR 20 51 59.87 1852.0

δ +0° 11' 09.9 1825.0 Am. p. +13.59
+6.08.0 .04
δ +0 17 17.9 1852.0

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Zone 15

Observed Nov. 11, 1852

	f	g	G	h	H	i			
Nov. 11	+22.82	+9.94	0°.45″	+19.73	37°.49′	+5.25″	α 20ʰ.00ᵐ	= 300°.00′	δ+0°.10
							α 21ʰ.00ᵐ	315°.00′	
							α 22ʰ.00ᵐ	330°.00′	

$p = (\alpha - t) + (d\alpha + dt)$ $\qquad q = (\delta - s) + (d\delta + dr') + (ds - dr)$

No. 24 1 obs.

Weisse H.XIX 1297 α 19ʰ.51ᵐ.32.69 δ+0°.16′.24.0
t 19ʰ.51ᵐ.32.10 s 0ʰ.16ᵐ.29.0
α−t = +0.69 δ−s = −6.0
dα+dt +0.97 dδ+dr' +10.1
p = +1.56 ds−dr +1.0
−.50
+1.06 q = +6.1

No. 26 1 obs.

Weisse H.XIX 1313 α 19ʰ.52ᵐ.24.45 δ+0°.14′.52.4
t 52ᵐ.24.45 s 0ʰ.14ᵐ.57
α−t = 0.00 δ−s = −4.6
dα+dt +0.99 dδ+dr' +10.2
p = +0.99 ds−dr +0.8
−.50
+0.49 q = +6.4

No. 30 1 obs.

Weisse H.XIX 1400 α 19ʰ.55ᵐ.40.61 δ+0°.17′.25.9
t 19ʰ.55ᵐ.40.35 s 0ʰ.17ᵐ.32
α−t = +0.26 δ−s = −6.1
dα+dt +0.99 dδ+dr' +10.2
p = +1.25 ds−dr +1.2
−.50
+0.75 q = +5.3

No. 55 1 obs.

Weisse H.XX 144 α 20ʰ.06ᵐ.42.68 δ+0°.17′.20.9
t 20ʰ.06ᵐ.42.90 s 0ʰ.17ᵐ.27
α−t = −0.22 δ−s = −6.1
dα+dt +1.06 dδ+dr' +10.7
p = +0.84 ds−dr +1.2
−.50
+0.34 q = +5.8

No. 61 2 obs.

Weisse H.XX 256 α 20ʰ.11ᵐ.03.49 δ+0°.11′.01.4
t 20ʰ.11ᵐ.03.75 s 0ʰ.11ᵐ.09
α−t = −0.26 δ−s = −7.6
dα+dt +1.09 dδ+dr' +10.8
p = +0.83 ds−dr +0.2
−.50
+0.33 q = +3.4

No. 62 2 obs.

Weisse H.XX 258 α 20ʰ.11ᵐ.07.23 δ+0°.15′.47.1
t 11ᵐ.07.40 s 0ʰ.15ᵐ.53
α−t −0.17 δ−s −5.9
dα+dt +1.09 dδ+dr' +10.8
p = +0.82 ds−dr +1.0
−.50
+0.32 q = +5.9

No. 64 2 obs.

Weisse HXX 304 α 20ʰ.12ᵐ.40.62 δ+0°.16′.51.6
t 20ʰ.12ᵐ.40.70 s 16ᵐ.57
α−t −0.08 δ−s −5.4
dα+dt +1.10 dδ+dr' +10.9
p = +1.02 ds−dr +1.2
−.50
+0.52 q = +6.7

No. 134 1 obs.

Weisse HXX 1340 α 20ʰ.51ᵐ.59.87 δ+0°.17′.17.9
t 20ʰ.51ᵐ.59.85 s 0ʰ.17ᵐ.23
α−t +0.02 δ−s −5.1
dα+dt +1.35 dδ+dr' +12.3
p = +1.37 ds−dr +1.3
−.50
+0.87 q = +8.5

p	q
1.56	6.1
0.99	6.4
1.25	5.3
0.84	5.8
0.83	3.4
0.83	3.4
0.82	5.9
0.82	5.9
1.02	6.7
1.02	6.7
1.37	8.5
11)135	11)64.1
p = +1.032	q = +5.83

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Value of μ after correcting Bessel's Zones $= +0''.578$

μ in α	μ in δ	μ	q'
$+1.06$	$+0.33$	$+0.46$	$+7''.6$
0.44	32	0.55	4.6
75	52	0.65	7.6
$+0.34$	$+0.87$	0.66	5.8
2.59	204	232	25.6
$+0.647$	$+0.51$	$+0.580$	$+6.4$
0.510			
1157			
$+0.578$			

By Bessel's stars $\mu = +0.578$ $q' = +5.83$
By stars in Zone 14 $\mu = +0.580$ $q' = +6.40$
Adopted Val. $\mu = +0.579$ $q' = +6.11$

Zone 14 No. 3 α 19h 49m 46.60 δ +0° 10′ 06.6
Zone 15 No. 21 t 19h 49m 47.10 s 10′ 09
$\alpha - t = -0.50$ $\delta - s = -2.4$
$d\alpha + dt = +0.96$ $d\delta + dr' = +10.0$
$\mu = +0.46$ $ds - dr = +0.0$
$q' = +7.6$

Zone 14 No. 19 α 20h 03m 33.72 δ 0° 10′ 00.1
Zone 15 No. 50 t 20h 3m 34.20 s 0° 10′ 06
$\alpha - t = -0.48$ $\delta - s = -5.9$
$d\alpha + dt = +1.03$ $d\delta + dr' = +10.5$
$\mu = +0.55$ $ds - dr = 0.0$
$q' = +4.6$

Zone 14 No. 90 α 20h 52m 53.73 δ +0° 10′ 13.3
Zone 15 No. 133 t 20h 51m 54.40 s 0° 10′ 18.0
$\alpha - t = -0.67$ $\delta - s = -4.7$
$d\alpha + dt = +1.32$ $d\delta + dr' = +17.3$
$\mu = +0.65$ $ds - dr = +0.0$
$q' = +7.6$

Zone 14 No. 155 α 21h 25m 29.84 δ +0° 09′ 40.4
t 21h 25m 30.75 s 0° 9′ 48
$\alpha - t = -0.91$ $\delta - s = -7.6$
$d\alpha + dt = +1.57$ $d\delta + dr' = +13.4$
$\mu = +0.66$ $ds - dr = 0.0$
$+5.8$

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OBSERVATORY OF HARVARD COLLEGE.

REDUCTION OF ZONES.

ZONE 16

[Form, No. 1.]

H	25° 07′	$\cdot = i$	$\cdot$
α	300°	$\cos\delta$	$\cdot$
$H+\alpha$	325° 07′	c'	$= +3.69$
$\sin(H+\alpha)$	$9^n.75733$	$\cos(H+\alpha)$	$\cdot$
sec δ	0.00000	$\sin\delta$	∞
$\cdot = h$	1.30276	h	$\cdot$
b	$1^n.06009 = -11.48$	b'	$\cdot = \cdot$
G	1° 18′		
$G+\alpha$	301° 18′		
$\sin(G+\alpha)$	$\cdot$	$\cos(G+\alpha)$	9.71560
tan δ	∞		
$\cdot = g$	$\cdot$	g	1.03100
a	$\cdot = \cdot$	a'	$0.74660 = +5.58$
			$+9.27$
f	$= +24.67$	$d\delta$	$= \cdot$
	13.19		
$d\alpha$ in seconds of arc	$= +13.19$	α	$= 20^h\ 00^m\ 00.878^s$
$-\frac{1}{3}$	4.39		
$d\alpha$ in seconds of time	$= +0.878^s$	δ	$= +0°\ 00′\ 09.27″$

H	25° 07′	$\cdot = i$	$\cdot$
α	315° 00′	$\cos\delta$	$\cdot$
$H+\alpha$	340° 07′	c'	$= +3.69$
$\sin(H+\alpha)$	$9^n.53161$	$\cos(H+\alpha)$	$\cdot$
sec δ	0.00000	$\sin\delta$	∞
$\cdot = h$	1.30276	h	$\cdot$
b	$0^n.83437 = -6.83$	b'	$\cdot = \cdot$
G	1° 18′		
$G+\alpha$	316° 18′		
$\sin(G+\alpha)$	$\cdot$	$\cos(G+\alpha)$	9.85912
tan δ	∞		
$\cdot = g$	$\cdot$	g	1.03100
a	$\cdot = \cdot$	a'	$0.89012 = +7.76$
			$+11.45$
f	$= +24.67$	$d\delta$	$= \cdot$
	17.84		
$d\alpha$ in seconds of arc	$= 17.84$	α	$= 21^h\ 00^m\ 01.180^s$
$-\frac{1}{3}$	5.95		
$d\alpha$ in seconds of time	$= +1.190^s$	δ	$= +0°\ 00′\ 11.45″$

H	25° 07′	$\cdot = i$	$\cdot$
α	330° 00′	$\cos\delta$	$\cdot$
$H+\alpha$	355° 07′	c'	$= +3.69$
$\sin(H+\alpha)$	$8^n.93007$	$\cos(H+\alpha)$	$\cdot$
sec δ	0.00000	$\sin\delta$	∞
$\cdot = h$	1.30276	h	$\cdot$
b	$0^n.23283 = -1.79$	b'	$\cdot = \cdot$
G	1° 18′		
$G+\alpha$	331° 18′		
$\sin(G+\alpha)$	$\cdot$	$\cos(G+\alpha)$	9.94307
tan δ	∞		
$\cdot = g$	$\cdot$	g	1.03100
a	$\cdot = \cdot$	a'	$0.97407 = +9.42$
			13.11
f	$= 24.67$	$d\delta$	$= \cdot$
	22.88		
$d\alpha$ in seconds of arc	$= +22.88$	α	$= 22^h\ 00^m\ 01.526^s$
$-\frac{1}{3}$	7.63		
$d\alpha$ in seconds of time	$= +1.526^s$	δ	$= +0°\ 00′\ 13.11″$

H	25° 07′	$\cdot = i$	$\cdot$
α	315° 00′	$\cos\delta$	$\cdot$
$H+\alpha$	340° 07′	c'	$= +3.69$
$\sin(H+\alpha)$	$9^n.53161$	$\cos(H+\alpha)$	9.97331
sec δ	0.00000	$\sin\delta$	7.46373
$\cdot = h$	1.30276	h	1.30276
b	$0^n.83437 = -6.83$	b'	$8.73980 = +0.06$
G	1° 18′		
$G+\alpha$	316° 18′		
$\sin(G+\alpha)$	$9^n.83940$	$\cos(G+\alpha)$	9.85912
tan δ	7.46373		
$\cdot = g$	1.03100	g	1.03100
a	$8.33413 = -0.02$	a'	$0.89012 = +7.76$
			11.51
f	$= +24.67$	$d\delta$	$= 11.51$
	$+17.82$		
$d\alpha$ in seconds of arc	$= +17.82$	α	$= 21^h\ 00^m\ 01.188^s$
$-\frac{1}{3}$	5.94		
$d\alpha$ in seconds of time	$= 1.188^s$	δ	$= +0°\ 10′\ 11.51″$

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OBSERVATORY OF HARVARD COLLEGE.

REDUCTION OF ZONES.

ZONE 16

[Form, No. 2.]

Sidereal Time = 22h 05m	Barometer = 30.000 in.	Att. Thermometer = 38.°	Ext. Thermometer = 24.8°
" = 24h 04	" = 30.030	" = 62.	" = 24.0
	.030		.8

α h. m.	dα s.	dt s.	dα+dt s.	p "	k = p − dα − dt "
20h 00	+ 0.878	+ 0.000	+ 0.878	+ 0.535	+ 0.343
21h 00	+ 1.190	.022	1.212	0.535	+ 0.677
22h 00	+ 1.526	+ 0.044	+ 1.570	+ 0.535	+ 1.035

α h. m.	dδ "	dr' "	dδ+dr' "	q "	d = q − dδ − dr' "
20h 00	+ 9.27	+ 0.00	+ 9.27	+ 11.87	+ 2.60
21h 00	+ 11.45	+ 0.08	11.53	11.87	+ 0.42 .34
22h 00	+ 13.11	+ 0.15	+ 13.26	+ 11.87	− 1.24 .39

correction of k for refraction, + 0.020
+ 0.002

Change of k for +10′ in Dec. = + 0.022 s.

Change of d for +10′ in Dec. = − 2.70 "

α h. m.	δ = ° ′ " k s.	δ = ° ′ " k s.	δ = ° ′ " d "	δ = ° ′ " d "
20h 00	− 0.34	− 0.32	+ 2.6	− 0.10
10	.40	.37	2.2	0.40
20	+ .45	.43	1.9	0.80
30	− .51	− .47	1.5	1.20
40	.56	.54	1.1	1.60
50	.62	.60	0.7	1.9
21h 00	0.68	.65	+ 0.3	2.3
10	.73	.71	− .0	2.7
20	.79	.77	0.3	3.0
30	.85	.83	0.6	3.3
40	.91	.89	0.8	3.5
50	.98	.96	1.1	3.8
22h 00	− 1.03	− 1.01	− 1.3	− 4.1

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Zeit of dα & dδ

α Agnesii

Mean α 21h 58m 10.757 δ − 1° 02′ 13.13

M 21h 58m 12.29 δ − 1° 02′ 00.4

+1.533 +12.73

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Zone 16th

Observed Nov. 24, 1852

	f	g	G	h	H	i		
Nov. 21	+24.22	+10.55	1°.13	+20.01	28°.00	+4".08	20h.00	α 300.00
" 26	+24.97	10.87	1.22	20.13	23.12	3.21	21.00	α' 315.00
24	+24.67	+10.74	1.18	+20.08	25.07	+3.69	22.00	α" 330.00

$p = (\alpha - t) + (d\alpha + dt)$ $\quad q = (\delta - s) + (d\delta + d\tau') + (ds - d\tau)$

No. 30 1 obs.

Weisse XX 220 α 20h 09m 29.97 δ +00° 02' 11".4

t 20h 09m 30.00 s 2m 08

α−t = −0.03 δ−s + 3.4

dα+dt + 0.93 dδ+dτ' + 9.6

p = +0.90 ds−dτ + 0.5

q = +13.5

−.50

+.40

No. 32 2 obs.

Weisse XX 269 α 20h 11m 24.75s δ +0° 08' 21.3

t 11 24.90 s 08.24

α−t = −0.15 δ−s = −2.7

dα+dt + 0.94 dδ+dτ' + 9.7

p +0.79 ds−dτ + 2.1

q = +9.1

−.50

+0.29

No. 90 2 obs.

Weisse XX 1479 α 20h 57m 46.41 δ +0° 08' 26.3

t 20h 57m 46.25 s 8.26.6

+0.16 δ−s +0.3

dα+dt + 1.06 dδ+dτ' +11.3

p = +1.22 ds+dτ + 2.1

q = +13.7

−.50

+0.72

No. 92 2 obs.

Weisse XX 1490 α 20h 58m 17.20 δ +0° 04' 16.4

t 20h 58m 17 s 4.12

α−t + 0.20 δ−s + 4.4

dα+dt + 1.06 dδ+dτ' +11.4

p = +1.26 ds+dτ + 1.0

q = +16.8

−.50

+0.74

No. 100 1 obs.

Weisse XXI 64 α 21h 04m 05.44 δ +0° 04' 36.6

t 4h 06m 00 s 4.35

α−t −0.56 +1.6

dα+dt + 1.24 dδ+dτ' +11.6

p = +0.68 ds−dτ + 1.0

−.50

+.18

q = +14.2

No. 116 4 obs.

Weisse XXI 303 (Gaetini 1483) α 21h 13m 28.62 δ +0° 03' 05.8

t 13.29.05 s 3.07

α−t −0.43 δ−s −1.2

dα+dt + 1.29 dδ+dτ' + 11.8

p = +0.86 ds−dτ + 0.8

−.23

+0.61

q = +12.4

No. 120 1 obs.

Weisse XXI 379 α 21h 16m 41.74 δ −0° 00' 14.1

t 16.42.10 s −0.00.15

α−t −0.36 δ−s +0.9

dα+dτ + 1.31 dδ+dτ' + 12.0

p = +0.95 ds−dτ 0.0

−.50

+0.45

q = +12.9

No. 153 3 obs.

Weisse XXI 951 α 21h 39m 20.62 δ +0° 10' 19.9

t 39.20.90 s 10.23.

α+t = −0.28 δ−s −03.1

dα+dt = +1.45 dδ+dτ' + 12.6

p = +1.17 ds−dτ + 2.7

−.33

+0.84

q = +12.2

p	q'	p	q	f	p
+0.90	+13.5	+0.86	+12.4	+0.40	+1.18
0.79	9.1	0.86	12.4	0.29	.61
0.79	9.1	0.86	12.4	0.72	.45
1.22	13.7	0.86	12.4	0.96	.84
1.22	13.7	0.95	12.9	2.17	20.8
1.26	16.8	1.17	12.2	.54	5.2
1.26	16.8	1.17	12.2	5.2	
0.68	14.2	1.17	12.8	106	
8.12	106.9	7.90	3.1	+0.530	
+1.015	+13.36	0.990	12.39		
.990	12.39				
2.005	5.75				
s +1.002	+12.87				

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Value of p. derived from stars in Zone 14

t	α	α−t	s	δ	δ−s	p +0.566
19h 54m 56.25s	55.86	−0.39	+0° 06′ 38″	6° 38′ 9	+0° 00′ 9	.527
55m 6.50	6.15	.35	3″ 47	3″ 47.3	+ 0.3	.529
56m 13.55	13.39	.16	0″ 21	0″ 20.8	− 0.2	122
59 23.25	22.98	.27	4″ 20	4″ 20.0	0.0	+0.541
		117			10	
		α−t −0.292			+0.25	
		dα+dt +0.858			dδ+dt′+9.05	q = +9.80
		+0.566			ds−dt +0.50	11.43
20h 42m 28.00	27.43	−0.57	0″ 04″ 47	4″ 46.4	−0.6 +9.80	11.40
43m 19.30	18.78	.52	8″ 31	8″ 29.9	1.1	3263
44m 03.20	2.57	.63	4″ 42	4″ 41.4	0.6	+10.876
44m 33.95s	33.37	58	7″ 16	7″ 15.0	1.0	
		230			33	
		α−t −0.575s			δ−s −0.825	
		dα+dt 1.102			dδ+dt′+10.85s	
		+0.527			ds−dt+1.4	
		α−t			q = +11.43	
21h 36m 44.70	6h 43m 87	−0.83	+0m 06s 52.0	6″ 51.6	− 0.4	
37m 57.65	56.65	1.00	0″ 1.0	10.5s	− 0.5s	
38m 54.10	53.25s	0.85s	2″ 01.	1″ 59.2	− 1.8	
39m 20.90	39m 19.96	− 0.94	10″ 23.	10″ 21.9	− 1.1	
		3.62			3.8	
		α−t −0.905s			δ−s −1.95s	
		dα+dt+1.434			dδ+dt′+12.55s	
		p = +0.529			ds−dt +0.80	
					q = +11.40	

By Cat. stars p = +0.530 q = +12.87

By Zone 14 p = +0.541 q = +10.87

71

Adopted val. p+0.535 11.87

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OBSERVATORY OF HARVARD COLLEGE.

REDUCTION OF ZONES.

ZONE 17

[Form, No. 1.]

H	19° 23′	″ . $=i$.	
α	292° 30	cos. δ .	
$H+\alpha$	311° 53	c'	$=+2.91$
sin. $(H+\alpha)$	9.87187	cos. $(H+\alpha)$	9.82453
sec. δ	0.00000	sin. δ	7.46373
$=h$	1.30557	h	1.30557
b	1.17744 $=-15.05$	b'	8.59383 $=+0.04$
G	1° 27′		
$G+\alpha$	293° 57		
sin. $(G+\alpha)$	9.96090	cos. $(G+\alpha)$	9.60846
tan. δ	7.46373		
$=g$	1.04689	g	1.04689
a	8.47152 $=-0.03$	a'	0.65536 $=+4.52$
	$f=+25.59$		$+7.47$
	$+10.51$	$d\delta$	$=$.
$d\alpha$ in seconds of arc	$=+10.51$		h m s
	$-\frac{1}{3}$ 3.50	$\alpha=$	19° 30′ 00.700
$d\alpha$ in seconds of time	s. $=+0.700$	$\delta=$	+0° 10′ 07.47

H	19° 23′	″ . $=i$.	
α	307° 30	cos. δ .	
$H+\alpha$	326° 53	c'	$=+2.91$
sin. $(H+\alpha)$	9.73747	cos. $(H+\alpha)$	9.92302
sec. δ	0.00006	sin. δ	7.46373
$=h$	1.30557	h	1.30557
b	1.04304 $=-11.04$	b'	8.69232 $=+0.05$
G	1° 27′		
$G+\alpha$	308° 57		
sin. $(G+\alpha)$	9.89081	cos. $(G+\alpha)$	9.79840
tan. δ	7.46373		
$=g$	1.04689	g	1.04689
a	8.40093 $=-0.02$	a'	0.84529 $=+7.00$
	$f=+25.59$		6.96
	$+14.53$	$d\delta$	$=$.
$d\alpha$ in seconds of arc	$=+14.53$		h m s
	$-\frac{1}{3}$ 4.84	$\alpha=$	20° 30′ 00.968
$d\alpha$ in seconds of time	s. $=+0.968$	$\delta=$	+0° 10′ 09.96

H	19° 23′	″ . $=i$.	
α	322° 30	cos. δ .	
$H+\alpha$	341° 53	c' .	$=+2.91$
sin. $(H+\alpha)$	9.49269	cos. $(H+\alpha)$	9.97792
sec. δ	0.00000	sin. δ	7.46373
$=h$	1.30557	h	1.30557
b	0.79826 $=-6.28$	b'	8.74722 $=+0.06$
G	1° 27′		
$G+\alpha$	323° 57		
sin. $(G+\alpha)$	9.76974	cos. $(G+\alpha)$	9.90768
tan. δ	7.46373		
$=g$	1.04689	g	1.04689
a	8.28036 $=+0.02$	a'	0.95457 $=+9.00$
	$f=+25.59$		11.97
	$+19.29$	$d\delta$	$=$.
$d\alpha$ in seconds of arc	$=+19.29$		h m s
	$-\frac{1}{3}$ 6.43	$\alpha=$	21° 30′ 01.286
$d\alpha$ in seconds of time	s. $=+1.286$	$\delta=$	+0° 10′ 11.97

H	19° 23′	″ . $=i$.	
α	307° 30	cos. δ .	
$H+\alpha$	326° 53	c'	$=+2.91$
sin. $(H+\alpha)$	9.73747	cos. $(H+\alpha)$	9.92302
sec. δ	0.00001	sin. δ	7.76475
$=h$	1.30557	h	1.30557
b	1.04305 $=-11.04$	b'	8.99334 $=+0.09$
G	1° 27′		
$G+\alpha$	308° 57		
sin. $(G+\alpha)$	9.89081	cos. $(G+\alpha)$	9.79840
tan. δ	7.76476		
$=g$	1.04689	g	1.04689
a	8.60146 $=-0.04$	a'	0.84529 $=+7.00$
	$f=+26.59$		10.00
	$+14.51$	$d\delta$	$=$.
$d\alpha$ in seconds of arc	$=+14.51$		h m s
	$-\frac{1}{3}$ 4.84	$\alpha=$	20° 30′ 00.968
$d\alpha$ in seconds of time	s. $=+0.968$	$\delta=$	+0° 20′ 10.00

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OBSERVATORY OF HARVARD COLLEGE.

REDUCTION OF ZONES.

ZONE 17

[Form, No. 2.]

Sidereal Time	Barometer	Att. Thermometer	Ext. Thermometer
h. m.	in.	°	°
22 „ 17	30.348	62.	33.8
„ = 00 „ 09	„ = 30.340 / .008	" = 63.	" = 32.9 / 0.9

α	dα	dt	dα+dt	p	k = p − dα − dt
h. m.	s.	s.	s.		s.
19 „ 30	+0.700	+0.000	+0.700	+0.975	+0.275
20 „ 30	0.968	0.025	+0.993	+0.975	−0.018
21 „ 30	+1.286	+0.050	+1.336	+0.975	−0.361

α	dδ	dr'	dδ+dr'	q	d = q − dδ − dr'
h. m.	"	"	"	"	"
19 „ 30	+7.47	+0.00	+7.47	+4.54	−2.93
20 „ 30	+9.96	+0.05	+10.01	+4.54	−5.47
21 „ 30	+11.97	+0.11	+12.08	+4.64	−7.54

corr. of k for refraction +0.022

Change of k for +10′ in Dec. = s. +0.022

Change of d for +10′ in Dec. = − 2.04

	"	+0.11		
1.52	dr'	−0.01 / +0.10		
for 8m		+0.01		
2 „ 00		+0.11 = dr'		

ds = +0.072 (65.8 − t)

t = 33.3

65.8

65.8 − t = +32.5

+.072

65.0

2275

ds = 2.3400

dr = 0.34

ds − dr = +2.000

ds = +9.96

ds' = +10.00

ds − ds' = −0.04

ds − dr = +2.00

d = (ds − ds') − (ds − dr) = −2.04

	δ = ° ′	δ = ° ′	δ = + 0 „ 10	δ = + 0 „ 20
α	k	k	d	d
h. m.	s.	s.	"	"
19 „ 30	+0.27	+0.30	−2.93	−0.9 −4.97
„ 40	.23	.25	3.4	1.3 5.5
„ 50	.18	.20	3.8	1.8 5.8
20 „ 00	.13	.15	4.2	2.2 6.2
„ 10	.08	.10	4.6	2.6 6.6
„ 20	+0.03	.05	5.0	3.0 7.0
„ 30	−0.02	+0.00	5.47	3.4 7.5
„ 40	.07	−0.05	5.8	3.8 7.9
„ 50	.13	.10	6.2	4.2 8.3
21 „ 00	.18	.16	6.6	4.5 8.7
„ 10	.24	.22	6.9	4.9 9.0
„ 20	.30	.28	7.2	5.2 9.3
„ 30	−0.36	−0.34	−7.54	−5.5 9.5

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Test of dαδδ

α Aquarii

A 21h 58m 10,755 D − 1° 02′ 13.13

α 21 58 12,21 δ − 1° 2′ 00.8

+1,455 +12.33

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Phone 17

Observed Nov. 30, 1852

	f	g	G	h	H	i		
Nov. 26	+24.97	+10.87	1°22'	+20.13	23°12'	+3.43	a 19h30m	= 292°30' δ=+0°10
Dec. 1	+25.74	+11.21	1°28	20.23	18°26	+2.78	a 20h30m	307°30
Nov.	+25.59	+11.14	1°27	+20.21	19°23	+2.91	a 21h30m	322°30 δ=+0°10

$p = (\alpha - t) + (d\alpha + dt)$ $\quad q = (\delta - s) + (d\delta + dr') + (ds - dr)$

No. 22 1 obs.

Weisse H.XIX 1297
- a 19h 51m 32.69 — δ +0° 16' 24.0
- t 19 51 31.70 — s 0 16 29.0
- α−t = +0.99 — δ−s = −5.0
- dα+dt +0.80 — dδ+dr' +8.3
- p = +1.79 — ds−dr +1.2
- +1.29 — q = +4.5

No. 23 1 obs.

Weisse H.XIX 1313
- a 19h 52m 24.46s — δ +0° 14' 52.4
- t 19 52 24.00 — s 0 14 58
- α−t +.46s — δ−s −5.6
- dα+dt +0.81 — dδ+dr' +8.4
- p = +1.26 — ds−dr +1.0
- +0.76 — q = +3.8

No. 27 1 obs.

Weisse H.XIX 1400
- a 19h 55m 40.61 — δ +0° 17' 25.9
- t 19 55 39.40 — s 0 17 33
- α−t = +0.71 — δ−s = −7.1
- dα+dt +0.83 — dδ+dr' +8.8
- p = +1.54 — ds−dr +1.4
- +1.04 — q = +5.1

No. 50 1 obs.

Weisse H.XX 144
- a 20h 06m 42.68 — δ +0° 17' 20.9
- t 20 06 42.30 — s 0 07 26
- α−t = +0.38 — δ−s = +5.1
- dα+dt +0.88 — dδ+dr' +9.1
- p = +1.26 — ds−dr +1.4
- +0.76 — q = +5.4

No. 58 2 obs.

Weisse H.XX 256
- a 20h 11m 03.49 — δ +0° 11' 01.4
- t 20 11 03.10 — s 11 07
- α−t = +0.39 — δ−s = −5.6
- dα+dt +0.90 — dδ+dr' +9.2
- p = +1.29 — ds−dr +0.2
- +0.79 — q = +3.8

No. 69 2 obs.

Weisse H.XX 304
- a 20h 12m 40.62 — δ +0° 16' 51.6
- t 20 12 40.10 — s 0 16 57
- α−t = +0.52 — δ−s = −5.4
- dα+dt +0.91 — dδ+dr' = +9.3
- p = +1.43 — ds−dr = +1.4
- +0.93 — q = +5.3

No. 129 1 obs.

Weisse H.XX 1340
- a 20h 51m 69.87 — δ +0° 17' 17.9
- t 20 51 54.20 — s 0 17 25
- α−t = +0.67 — δ−s = −7.1
- dα+dt +1.12 — dδ+dr' = +10.6
- p = +1.79 — ds−dr = +1.4
- +1.24 — q = +4.9

p	q
+1.79	+4.6
1.26	3.8
1.54	5.1
1.26	5.4
1.29	3.8
1.29	3.8
1.43	5.3
1.43	5.3
1.79	4.9
40.8	9)41.9
1.453	+4.65

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Zone 17

μ		μ	q'
+1.29	+0.79	+0.90	+4.27
0.76	.93	1.01	4.28
1.04	1.29	0.974	4.41
0.76	307	2.884	96
365	1.003	+0.961	+4.32
0.962			
1.003			
1965			
+0.982			

By Bessel Zones $\mu = +0.982$ $q' = +4.65$
By stars in Zone 15 $\mu = +0.961$ $q' = +4.32$
Adopted Value $\mu = +0.975$ $q' = +4.54$

Zone 15 No. 1 α 19h 39m 19.68s
Zone 17 No. t 19h 39m 19.55s
$\alpha - t$ +0.13
$d\alpha + dt$ + 6.00
$\mu = +6.13$

t	α	$\alpha - t$	δ	s	$\delta - s$	t	α	$\alpha - t$
19h 39m 19.55s	39m 19.68s	+0.13	+0° 15′ 04.1″	0h 15m 09s	− 4.9″	21h 20m 57.10s	21h 20m 56.82s	−0.28
39m 29.85s	29.98	0.13	16 03.1	15 07	−3.9	23h 25m 95s	23h 25m 60s	−.35
40m 08.00s	8m 03	0.03	12 13.3	12 18	−4.7	24h 07m 15s	24h 6m 75s	−.40
40m 14.60s	14.88	0.28	12 23.3	12 27	−3.7	24h 08m 05s	24h 07.74s	−.31
40m 57.55s	57.68	0.13	15 03.1	15 07	−3.9	25h 30m 05s	25h 29.79s	−.26
		70			211			160
		$\alpha - t$ +0.14			$\delta - s$ −4.22			$\alpha - t$ −0.320
		$d\alpha + dt$ + 0.76			$d\delta + d\gamma'$ + 7.87			$d\alpha + dt$ + 1.294
		$\mu = +0.90$			$ds - dr$ + 0.62			$\mu = +0.974$
					$q' = +4.27$			

t	α	$\alpha - t$	δ	s	$\delta - s$	δ	s	$\delta - s$
20h 31m 04.20s	31m 04.33s	+0.13s	+0° 12′ 46.1″	0h 12m 53s	− 6.9″	+0° 10′ 49.8″	0h 10m 59s	+ 9.2″
31m 26.20s	31m 25.28s	+0.08	13 2.0	13 09	− 7.0	14 39.9	14 48	− 8.1
32m 14.25s	32m 14.32s	+0.07	20 14.6	20 23	− 8.4	16 42.4	16 51	− 8.6
32m 43.95s	32m 43.77s	−0.18	9 38.4	9 43	− 4.6	14 18.9	14 27	− 8.1
33m 12.10s	33m 12.07s	−0.03	13 33.8	13 40	− 6.2	0° 09′ 40.7″	9 48	− 7.3
		+0.07			331			413
		$\alpha - t$ +0.09			$\delta - s$ −6.62			$\delta - s$ −8.26
		$d\alpha + dt$ + 1.00			$d\delta + d\gamma'$ +10.10			$d\delta + d\gamma'$ +11.87
		$\mu = +1.01$			$ds - dr$ + 0.80			$ds - dr$ + 0.80
					$q' = +4.28$			$q' = +4.41$

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OBSERVATORY OF HARVARD COLLEGE.

REDUCTION OF ZONES.

ZONE 18 Observed Dec. 6, 1852

[Form, No. 1.]

H	13 h 43 m	H	13 h 43 m
α	22 h 30 m	α	23 h 30 m
$H+\alpha$	336° 13′	$H+\alpha$	351° 13′
sin. $(H+\alpha)$	$\bar{9}^m.60561$	sin. $(H+\alpha)$	$\bar{9}^m.18383$
sec. δ	0.00000	sec. δ	0.00000
$=h$	1.30771	$=h$	1.30771
b	$0^s.91332 = -8''.19$	b	$0^s.49154 = -3''.10$
G	1° 29′	G	1° 29′
$G+\alpha$	323° 59′	$G+\alpha$	338° 59′
sin. $(G+\alpha)$	9.76939	sin. $(G+\alpha)$	.
tan. δ	∞	tan. δ	∞
$=g$	.	$=g$	.
a	. = .	a	. = .
f	+26.54	f	+26.54
$d\alpha$ in seconds of arc	+18.35	$d\alpha$ in seconds of arc	+23.44
$-\frac{1}{3}$	6.116	$-\frac{1}{3}$	7.813
$d\alpha$ in seconds of time	$+1^s.223$	$d\alpha$ in seconds of time	$+1^s.563$

$=i$	.	$=i$	.
cos. δ	.	cos. δ	.
c'	$= +2''.10$	c'	$= +2''.10$
cos. $(H+\alpha)$	.	cos. $(H+\alpha)$	.
sin. δ	∞	sin. δ	∞
h	.	h	.
b'	. = .	b'	. = .
cos. $(G+\alpha)$	9.90787	cos. $(G+\alpha)$	9.97010
g	1.06296	g	1.06296
a'	$0.97083 = 9.35$	a'	$1.03306 = 10.79$
	+11.45		+12.89
$d\delta$	= .	$d\delta$	= .
α	= 21 h 30 m 01.223 s	α	= 22 h 30 m 01.563 s
δ	= +0° 00′ 11.45″	δ	= +0° 00′ 12.89″

H	13 h 43 m	H	13 h 43 m
α	352° 30′	α	337° 30′
$H+\alpha$	6° 13′	$H+\alpha$	351° 13′
sin. $(H+\alpha)$	9.03458	sin. $(H+\alpha)$	$\bar{9}^m.18383$
sec. δ	0.00000	sec. δ	0.00000
$=h$	1.30771	$=h$	1.30771
b	$0^s.34229 = 2''.20$	b	$0^s.49154 = -3''.10$
G	1° 29′	G	1° 29′
$G+\alpha$	353° 59′	$G+\alpha$	338° 59′
sin. $(G+\alpha)$	.	sin. $(G+\alpha)$	$\bar{9}^m.55466$
tan. δ	∞	tan. δ	7.46373
$=g$	.	$=g$	1.06296
a	. = .	a	$\bar{8}^m.08135 = -0^s.01$
f	26.54	f	+26.54
$d\alpha$ in seconds of arc	+28.74	$d\alpha$ in seconds of arc	+23.93
$-\frac{1}{3}$	9.580	$-\frac{1}{3}$	7.81
$d\alpha$ in seconds of time	$+1^s.916$	$d\alpha$ in seconds of time	$+1^s.562$

$=i$	.	$=i$	.
cos. δ	.	cos. δ	.
c'	$= 2''.10$	c'	$= +2''.10$
cos. $(H+\alpha)$	.	cos. $(H+\alpha)$	9.99488
sin. δ	∞	sin. δ	7.46373
h	.	h	1.30771
b'	. = .	b'	$8.76632 = 0.06$
cos. $(G+\alpha)$	9.99760	cos. $(G+\alpha)$	9.97010
g	1.06296	g	1.06296
a'	$1.06056 = 11.50$	a'	$1.03306 = 10.79$
	+13.60		+12.95
$d\delta$	= .	$d\delta$	= .
α	= 23 h 30 m 01.96 s	α	= ° ′ ″
δ	= +0° 00′ 13.60″	δ	=

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OBSERVATORY OF HARVARD COLLEGE.

REDUCTION OF ZONES.

ZONE 18

[Form, No. 2.]

Sidereal Time = 23 h. 25 m.
" = 1 " 19
1 " 54

Barometer = 30.000 in.
" = 30.000
000

Att. Thermometer = 65°.
" = 68.

Ext. Thermometer = 44.0 °
" = 41.3
2.7

" + 0.30 = dr'
dr = 0.34
ds = 1.49
ds - dr = + 1.15
dδ 12.89
dδ' 12.95
dδ - dδ' = - 0.06
d(dδ - dδ') - (ds - dr) = - 1.21

α h. m.	dα s.	dt s.	dα + dt s.	p "	k = p − dα − dt "
21 " 30	+ 1.223	+ 0.000	+ 1.223	.	.
22 " 30	+ 1.563	.027	+ 1.590	.	.
23 " 30	+ 1.916	+ 0.054	+ 1.970	.	.

α h. m.	dδ "	dr' "	dδ + dr' "	q "	d = q − dδ − dr' "
21 " 30	+ 11.45	+ 0.00	+ 11.45	.	.
22 " 30	+ 12.89	.14	+ 13.03	.	.
23 " 30	+ 13.60	+ 0.29	+ 13.89	.	.

Change of k for +10′ in Dec. = s. .

Change of d for +10′ in Dec. = − 1.21 "

δ = ° ′ " δ = ° ′ " δ = ° ′ " δ = ° ′ "

α h. m.	k s.	k s.	d "	d "
"	.	.	.	.
"	.	.	.	.
"	.	.	.	.
"	.	.	.	.
"	.	.	.	.
"	.	.	.	.
"	.	.	.	.
"	.	.	.	.
"	.	.	.	.
"	.	.	.	.
"	.	.	.	.
"	.	.	.	.

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Dec. 6, 1852

Test of da & dδ

a Aquarii

Mean AR	21h 58m 10.755s	Dec. −1° 02′ 13.13″
App. "	21h 58m 12.15s	1° 2′ 1.2″
	da = +1.395s	dδ = +11.93″
comp. = da	1.390	dδ 11.91

W. H XXI 3 obs.

AR 21h 37m 57.73s 1825.0 Am.p. 3.070
+ 1m 22.89s 27
21h 39m 20.62s 1852.0 21490 6140 82890
cor. −.34
21h 39m 20.28s

δ + 0° 02′ 57.9″ 1825.0 Am.p. + 16.33
7m 21.7s + .03
+ 0° 10′ 19.6″ 1852.0 +16.36 27
11452 3272 44172

Santini 1519 2 obs.

AR 21h 42m 21.18s 1840.0 Am.p. 3.070
+ 36.84 12
21h 42m 58.02s 1852.0 6140 3070 36840

δ + 0° 00′ 34.7″ 1840 Am.p. 16.546
+ 3m 18.79s + .01
+ 0° 03′ 53.49″ 1852 16.566 12
33132 16566 19.8792

W H XXI 1032 3 obs.

AR 21h 42m 04.00s 1825.0 Am.p. 3.070
+ 1m 22.89s 27
21h 43m 26.89s 1852.0 21490 6140 82890
cor. −.34
21h 43m 26.55s

δ − 0° 03′ 09.8″ 1825.0 Am.p. 16.53
+ 7m 26.9s + .03
+ 0° 04′ 17.1″ 1852.0 +16.56 27
18572 3812 44692

W H XXI 1044 3 obs.

AR 21h 42m 37.33s 1825.0 Am.p. 3.070
+ 1m 22.89s 27
21h 44m 00.22s 21490 6140 82890
cor. −.37
21h 43m 59.88s 1852.0

δ − 0° 02′ 38.1″ 1825.0 Am.p. 16.56
+ 7m 27.9s + .03
+ 0° 04′ 49.8″ 16.59 27
11613 3318 44793

W. H XXII 112 2 obs.

AR 22h 04m 52.84s 1825.0 Am.p. 3.070
+ 1m 22.89s 27
22h 06m 15.73s 1852.0 21490 6140 82890

δ + 00° 00′ 54.4″ 1825.0 Am.p. 17.58
+ 7° 35′ 5″ + .03
+ 0° 08′ 49.9″ 17.61 27
12327 3522 47547

W H XXII 214 10 obs.

AR 22h 09m 34.41s 1825.0 Am.p. 3.070
1m 22.89s 27
22h 10m 57.30s 1852.0 21490 6140 82890

δ − 0° 00′ 03.7″ 1825 Am.p. 17.77
+ 8° 00′ 3″ + .02
+ 0° 07′ 56.6″ 17.79 27
12453 3558 48033

W. H XXII 292 1 obs.

AR 22h 13m 06.95s 1825.0 Am.p. 3.071
+ 1m 22.92s 27
22h 14m 28.87s 21497 6142 82917

δ − 0° 05′ 52.9″ 1825.0 Am.p. 17.91
+ 8° 04′ 1″ + .02
+ 0° 02′ 11.2″ 17.93 27
12551 3586 48411

W. H. XXII 293 10 obs.

AR 22h 13m 07.45s 1825.0 Am.p. 3.071
1m 22.92s 27
22h 14m 30.37s 1852.0 21497 6142 82917

δ − 0° 07′ 50.5″ 1825.0 Am.p. 17.91
+ 8° 04′ 1″
+ 0° 00′ 13.6″

W. H. XXII 305 1 obs. Am.p. 3.070
27
AR 22h 13m 47.70s 1825.0 21490 6140 82890
+ 1m 22.89s
22h 15m 10.59s 1852.0

δ − 0° 03′ 25.1″ 1825 Am.p. 17.94
+ 8° 04′ 9″ + .02
δ + 0° 04′ 39.8″ 17.96 27
12572 3592 48492

W. H. XXII 741 10 obs.

AR 22h 38m 26.80s 1825.0 Am.p. 3.071
+ 1m 22.92s 27
22h 34m 49.72s 1852.0 21497 6142 82917

δ − 0° 08′ 29.7″ 1825.0 Am. 18.64
+ 8° 23′ 8″ + .02
δ − 0° 00′ 05.9″ 1852.0 18.66 27
13062 3732 50382

W. H. XXII 1026 10 obs.

AR 22h 47m 55.59s 1825.0 Am.p. 3.070
+ 1m 22.89s 27
22h 49m 18.48s 1852.0 21490 6140 82890

δ − 0° 02′ 38.7″ Am.p. 19.07
+ 8° 35′ 4″ + .02
+ 0° 05′ 56.7″ 19.09 27
13363 3818 51543

Santini 1600 2 obs.

AR 22h 51m 15.76s 1840.0 Am.p. 3.070
+ 36.84 12
22h 51m 52.60s 1852.0 6140 3070 36840

δ + 00° 06′ 36.9″ 1840.0 19.161
+ 3° 49′ 9″ 12
+ 0° 10′ 26.8″ 38322 19161 229932

Taylor 10595 6 obs.

AR 22h 51m 00.29s 1835.0 Am.p. 3.071
+ 52.21 17
22h 51m 52.50s 1852.0 21497 3071 52207

δ + 0° 05′ 01.58″ 1835.0 Am.p. + 19.156
+ 5° 25′ 65″ 17
+ 0° 10′ 27.53″ 134092 19156 325652

W. H. XXII 1034 10 obs.

AR 22h 50m 29.60s 1825.0 Am.p. 3.070
+ 1m 22.89s 27
22h 51m 52.49s 1852.0 21490 6140 82890
δ + 0° 01′ 50.7″ 1825.0 Am.p. 19.14
+ 8° 37′ 3″ 02
0° 10′ 28.0″ 19.16 27
13412 3832 51732

Santini 1616 2 obs.

AR 23h 05m 17.85s 1840.0 3.070
+ 36.84 12
23h 05m 54.69s 1852.0 6140 3070 36840

δ + 0° 03′ 43.1″ 1840.0 19.487
+ 3° 53′ 8″ 12
+ 0° 07′ 36.9″ 1852.0 38974 19487 233844

W. H. XXII 91 10 obs.

AR 23h 04m 31.78s 1840.0 Am.p. 3.070
+ 1m 22.89s 27
23h 05m 54.67s 1852.0 21490 6140 82890

δ − 0° 01′ 08″.3 1825.0 Am.p. 19.47
+ 8° 46′ 2″ + .02
+ 0° 07′ 37.9″ 19.49 27
13643 3898 52623

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Done 18

Observed December 6, 1852

	f	g	G	h	H	i			
Dec. 6	+26".54	+11".56	1°.29	+20".31	13°.43	+2".10	a	21h.30m	322°.30'
							a'	22.30	337.30
							a''	23.30	352.30

δ +0°.00'

$p = (\alpha - t) + (d\alpha + dt)$ $q = (\delta - s) + (d\delta + d\delta') + (ds - d\sigma)$

4m 5s No. 10 3 obs.

Weisse 951 a 21h.39m.20s.46 δ +0°.10'.15".6
s 10.26.
δ−s = −6.4
dδ+dδ' +11.7
ds−dσ +1.1
q = +2.4

No. 59 1 obs.

Weisse 214 a 22h.10m.57s.30 δ +0°.07'.66".6
t 22.10.57.65 s 0°.08'.06
a−t −0.35 δ−s −9.4
dα+dt +1.46 dδ+dδ' +12.4
p = 1.11 ds−dσ +.7
q = +3.7

No. 15 2 obs.

Santini 1519 a 21h.42m.58s.02 δ +0°.03'.53".44
Weisse 1022 3 obs — — — 21 42 58.40 21
t 21.42.58.55 s 0°.04'.02
a−t −0.39 δ−s −8.57
dα+dt +1.29 dδ+dδ' +11.7
p = +0.95 ds−dσ +0.4
q = +3.6

No. 63 1 obs.

Weisse 292 a 22h.14m.28s.87 δ +0°.02'.11".2
t 22.14.28.60 s 2".17
a−t +0.27 δ−s −5.8
dα+dt +1.49 dδ+dδ' +12.6
p = +1.76 ds−dσ +0.3
q = +7.1

No. 17 3 obs.

Weisse 1032 a 21h.43m.26s.56 δ +0°.04'.17".1
t 43.26.70 s 4".22
a−t +0.15 δ−s −4.9
dα+dt +1.30 dδ+dδ' +11.8
p = +1.45 ds−dσ +0.5
q = +7.4

No. 64 1 obs.

Weisse 293 a 22h.14m.30s.37 δ 0°.00'.13".6
t 14.30.60 s 0".21
a−t −0.27 δ−s +7.4
dα+dt +1.50 dδ+dδ' +12.7
p = +1.33 ds−dσ +0.0
q = +5.3

No. 19 3 obs.

Weisse 1044 a 21h.43m.59s.88 δ +0°.04'.49".8
t 21.44.00.00 s 0°.04'.56
a−t +0.12 δ−s = −6.2
dα+dt +1.36 dδ+dδ' +11.9
p = +1.24 ds−dσ +0.4
q = +6.1

No. 67 1 obs.

Weisse 305 a 22h.15m.10s.59 δ +0°.04'.39".8
t 22.15.11.10 s 0°.4'.44".0
a−t −0.51 δ−s −4.2
dα+dt +1.51 dδ+dδ' +12.8
p = +1.00 ds−dσ +0.6
q = +9.1

No. 48 2 obs.

Weisse 112 a 22h.06m.15s.73 δ +0°.08'.49".9
t 22.06.16.40 s 0°.08'.57
a−t −0.67 δ−s −07.1
dα+dt +1.44 dδ+dδ' +12.3
p = +0.77 ds−dσ +.9
q = +6.1

No. 103 1 obs.

Weisse 741 a 22h.34m.49s.72 δ +0°.00'.05".9
t s + 0°.01
δ−s −06.9
dδ+dδ' +13.1
ds−dσ +0.0
q = +6.2

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No. 131 1 obs.

Weisse 1026 α 22 49 18.48 δ +0 05 56.7

t 49 18.60 s 6 05.

α−t −0.12 δ−s −8.3

dα+dt+1.71 dδ+dr'+13.2

p = +1.59 ds−dr+0.6

qf = +5.5

No. 134

2 obs. Santini 1600 α 22 51 52.60 δ +00 10 26.8 wt. 3

6 obs. Taylor 10595 51 52.50 27.5 wt 5

1 obs. Weisse 1084 51 52.49 28.0 wt 2

Mean by weight 22 51 52.52 δ 00 10 27.4

t 51 53.15 s 10.35

δ−s = −0.63 δ−s −7.6

dα+dt +1.71 dδ+dr'+13.3

p = +1.08 ds−dr+1.1

qf = +6.8

No. 149

2 obs. Santini 1616 α 23 05 54.69 δ +0 07 36.9

1 obs. Weisse 91 α 54.67 7.37.9

Mean by wts. α 23 05 54.68 δ +0 07 37.2

t 23 05 55.00 s 0 07 46

α−t −0.32 δ−s −8.8

dα+dt +1.81 dδ+dr'+13.5

p = +1.49 ds−dr+0.8

qf = +5.5

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OBSERVATORY OF HARVARD COLLEGE.

REDUCTION OF ZONES.

ZONE 19 Observed Dec. 14, 1852

[Form, No. 1.]

H	6h 11m		
α	322° 30′		
$H+\alpha$	328° 41′		
sin. $(H+\alpha)$	9.71581	cos. $(H+\alpha)$	
sec. δ	0.00000	sin. δ	∞
$=h$	1.30963	h	
b	1m.02544 = −10″.60	b'	=
G	1° 20′		
$G+\alpha$	323° 50′		
sin. $(G+\alpha)$		cos. $(G+\alpha)$	9.90704
tan. δ	∞		
$=g$		g	1.08422
a	=	a'	0.99126 = +9″.80
	f = +27″.87		+10″.75
		$d\delta$	=
$d\alpha$ in seconds of arc	= +17″.27	α =	21h 30m 01s.152
$-\frac{1}{3}$	5″.75		
$d\alpha$ in seconds of time	= +1s.152	δ =	+0° 00′ 10″.75

H	6h 11m		
α	337° 30′		
$H+\alpha$	343° 41′		
sin. $(H+\alpha)$	9.44862	cos. $(H+\alpha)$	
sec. δ	0.00000	sin. δ	∞
$=h$	1.30963	h	
b	0m.75825 = −5″.73	b'	=
G	1° 20′		
$G+\alpha$	338° 57′		
sin. $(G+\alpha)$		cos. $(G+\alpha)$	9.96971
tan. δ	∞		
$=g$		g	1.08422
a	=	a'	1.05393 = +11″.32
	f = +27″.87		+12″.27
		$d\delta$	=
$d\alpha$ in seconds of arc	= 22″.14	α =	° ′ ″
$-\frac{1}{3}$	7″.38		
$d\alpha$ in seconds of time	= +1s.476	δ =	

H	6h 11m		
α	352° 30′		
$H+\alpha$	358° 41′		
sin. $(H+\alpha)$	8.36131	cos. $(H+\alpha)$	
sec. δ	0.00000	sin. δ	∞
$=h$	1.30963	h	
b	9m.67094 = −0″.47	b'	=
G	1° 20′		
$G+\alpha$	353° 50′		
sin. $(G+\alpha)$		cos. $(G+\alpha)$	9.99748
tan. δ	∞		
$=g$		g	1.08422
a	=	a'	1.08170 = +12″.07
	f = +27″.87		+13″.02
		$d\delta$	=
$d\alpha$ in seconds of arc	= +27″.40	α =	° ′ ″
$-\frac{1}{3}$	9″.13		
$d\alpha$ in seconds of time	= +1s.827	δ =	

H	6h 11m		
α	337° 30′		
$H+\alpha$	343° 41′		
sin. $(H+\alpha)$	9.44862	cos. $(H+\alpha)$	9.98215
sec. δ	0.00000	sin. δ	7.46373
$=h$	1.30963	h	1.30965
b	0m.75825 = −5″.73	b'	8.75553 = +0″.06
G	1° 20′		
$G+\alpha$	338° 50′		
sin. $(G+\alpha)$	9.55761	cos. $(G+\alpha)$	9.96866
tan. δ	7.46373		
$=g$	1.08422	g	1.08422
a	8.10556 = −0″.01	a'	1.05388 = +11″.32
	f = +27″.87		+12″.33
		$d\delta$	=
$d\alpha$ in seconds of arc	= +22″.13	α =	° ′ ″
$-\frac{1}{3}$			
$d\alpha$ in seconds of time	=	δ =	

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OBSERVATORY OF HARVARD COLLEGE.

REDUCTION OF ZONES.

ZONE 19 [Form, No. 2.]

Sidereal Time = 23 h. 36 m. Barometer = 30·480 in. Att. Thermometer = 63·0 ° Ext. Thermometer = 20·2 °

" = 1 " 20 " = 30·520 " = 63·0 " = 18·2

1 " 44 0·040 2·0

+0·22
+0·04
+0·26 for 1 h 44 m
0·27 " 2 hrs

α h. m.	$d\alpha$ s.	dt s.	$d\alpha+dt$ s.	p "	$k=p-d\alpha-dt$ "
21 " 30	+1·152	+0·000	+1·152	.	.
22 " 30	+1·476	+0·030	+1·506	.	.
23 " 30	+1·827	+0·060	+1·887	.	.

dr = +0"·30
h. angle corr. +0·03
dr = +0·33
ds = +2·88
$ds-dr$ +2·55

α h. m.	$d\delta$ "	dr' "	$d\delta+dr'$ "	q "	$d=q-d\delta-dr'$ "
21 " 30	+10·75	+0·00	+10·75	.	.
22 " 30	12·27	+0·14	+12·41	.	.
23 " 30	13·02	+0·27	+13·29	.	.

$d\delta$ 12·27
$d\delta'$ 12·33
$d\delta-d\delta'$ −·06

$d=(d\delta-d\delta')-(ds-dr)=-2·61$

Change of k for +10′ in Dec. = s. .

Change of d for +10′ in Dec. = − 2·61 "

δ = ° ′ " δ = ° ′ " δ = ° ′ " δ = ° ′ "

α h. m.	k s.	k s.	d "	d "
"	.	.	.	.
"	.	.	.	.
"	.	.	.	.
"	.	.	.	.
"	.	.	.	.
"	.	.	.	.
"	.	.	.	.
"	.	.	.	.
"	.	.	.	.
"	.	.	.	.
"	.	.	.	.
"	.	.	.	.
"	.	.	.	.

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Dec. 14, 1852

Test of da & dδ
α Aquarii

Mean AR	21h 58m 10·755	Dec.	−1° 02′ 13·13
App. "	58 12·06		1 2 1·9
	da 1·305		dδ 11·23
Comp.	da 1·307		dδ 11·19

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Nova 19

Observed Dec. 14, 1852

	f	g	G	h	H	i			
Dec. 11	+ 27".36	+ 11".92	1°.25	+ 20".37	9°.00	+ 1".39	a 21h.30	322°.30	δ + 0°.00
" 16	28.19	+ 12.28	1.18	+ 20.41	4.19	+ 0.67	a 22h.30	337.30	
" 14	+ 27.87	+ 12.14	1.20	+ 20.40	6.11	+ 0.55	a 23h.30	352.30	

$p = (a - t) + (da + dt)$ $q = (\delta - s) + (d\delta + dr') + (ds - dr)$

No. 10 3 obs.

Weisse 967 a 21h.39m.20s.28 δ + 0°.10'.19".6 3 obs

t	21h.39m.20s.40	s	0°.10'.24"
a − t	− 0.12	δ − s	− 4.4
da + dt	+ 1.21	dδ + dr'	+ 11.0
p =	+ 1.09	ds − dr	+ 2.6
		q =	+ 9.2

No. 12

1 obs. Santini 1519 a 21h.42m.58s.02 δ + 0°.03'.53".49 − 2 obs

3 obs. Weisse 1022 a 42m.58s.40 3'.56".9 3 obs

42 10.39

a	21h.42m.58s.21	δ +	0°.03'.55".2
t	21h.42m.58s.80		0°.04'.01
a − t	− 0.59	δ − s	− 5.8
da + dt	+ 1.22	dδ + dr'	+ 11.1
p =	+ 0.63	ds − dr	+ 1.0
		q =	+ 6.3

No. 15

Weisse 1032 a 21h.43m.26s.55 δ + 0°.04'.17".1 3 obs

t	21h.43m.27s.00	s	0°.4'.21"
a − t	− 0.45	δ − s	− 3.9
da + dt	+ 1.23	dδ + dr'	+ 11.1
p =	+ 0.78	ds − dr	+ 1.1
		q =	+ 8.3

No. 16

Weisse 1044 a 21h.43m.59s.88 δ + 0°.04'.49".8

t	21h.44m.00s.30	s	4'.55"
a − t	− 0.42	δ − s	− 5.2
da + dt	+ 1.23	dδ + dr'	+ 11.2
p	+ 0.81	ds − dr	+ 1.2
		q =	+ 7.2

No. 43

Weisse 112 a 22h.06m.15s.73 δ + 0°.08'.49".9

t	22h.06m.16s.70	s	0°.08'.56"
a − t	− 0.97	δ − s	− 6.1
da + dt	+ 1.38	dδ + dr'	+ 11.8
p =	+ 0.41	ds − dr	+ 2.0

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OBSERVATORY OF HARVARD COLLEGE.

REDUCTION OF ZONES.

ZONE 20 Observed Dec. 15, 1852

[Form, No. 1.]

H	5 ° 05 ′			H	5 ° 05 ′		
α	322 ″ 30			α	337 ″ 30		
$H+\alpha$	327 ″ 35			$H+\alpha$	342 ″ 35		
sin. $(H+\alpha)$	9.72922	cos. $(H+\alpha)$	9.92643	sin. $(H+\alpha)$	9.47613	cos. $(H+\alpha)$	9.97962
" sec. δ	0.00000	sin. δ	7.46373	" sec. δ	0.00000	sin. δ	7.46373
. $=h$	1.30963	h	1.30963	. $=h$	1.30963	h	1.30963
b	1.03885 $=-10.93$	b'	8.79979 $=+0.06$	b	0.78576 $=-6.11$	b'	8.75298 $=0.06$
G	1 ° 19 ′			G	1 ° 19 ′		
$G+\alpha$	323 ″ 49			$G+\alpha$	338 ″ 49		
sin. $(G+\alpha)$	9.77199	cos. $(G+\alpha)$	9.90648	sin. $(G+\alpha)$	9.55793	cos. $(G+\alpha)$	9.96962
" tan. δ	7.46373			" tan. δ	7.46373		
. $=g$	1.08672	g	1.08672	. $=g$	1.08672	g	1.08672
a	8.32244 $=-0.02$	a'	0.99320 $=+9.84$	a	8.10838 $=-0.01$	a'	1.05634 $=+11.38$
	$f=+28.03$		10.71		$f=+28.03$		12.25
	17.08				21.91		
$d\alpha$ in seconds of arc $=$	+17.08	$d\delta$	= .	$d\alpha$ in seconds of arc $=$	21.91	$d\delta$	= .
$-\frac{1}{3}$	5.69	$\alpha=$	h m s 21 ″ 30 ″ 01.139	$-\frac{1}{3}$	7.30	$\alpha=$	h m s 22 ″ 30 ″ 01.461
$d\alpha$ in seconds of time $=$	s. 1.139	$\delta=$	+ 0 ° 10 ′ 10.71	$d\alpha$ in seconds of time $=$	s. 1.461	$\delta=$	+ 0 ° 10 ′ 12.25

H	5 ° 05 ′			H	5 ° 05 ′		
α	352 ″ 30			α	337 ″ 30		
$H+\alpha$	357 ″ 35			$H+\alpha$	342 ″ 35		
sin. $(H+\alpha)$	8.62497	cos. $(H+\alpha)$	9.99961	sin. $(H+\alpha)$	9.47613	cos. $(H+\alpha)$	9.97962
" sec. δ	0.00000	sin. δ	7.46373	" sec. δ	0.00001	sin. δ	7.46475
. $=h$	1.30963	h	1.30963	. $=h$	1.30963	h	1.30963
b	9.93460 $=-0.86$	b'	8.77299 $=0.06$	b	0.78577 $=-6.11$	b'	9.05400 $=0.11$
G	1 ° 19 ′			G	1 ° 19 ′		
$G+\alpha$	353 ″ 49			$G+\alpha$	338 ″ 49		
sin. $(G+\alpha)$	9.03226	cos. $(G+\alpha)$	9.99747	sin. $(G+\alpha)$	9.55793	cos. $(G+\alpha)$	9.96962
" tan. δ	7.46373			" tan. δ	7.46476		
. $=g$	1.08672	g	1.08672	. $=g$	1.08672	g	1.08672
a	7.58271 $=0.00$	a'	1.08419 $=12.14$	a	8.10941 $=-0.01$	a'	1.05634 $=11.38$
	$f=+28.03$		13.01		$f=+28.03$		12.30
	+27.17				21.91		
$d\alpha$ in seconds of arc $=$	27.17	$d\delta$	= .	$d\alpha$ in seconds of arc $=$	21.91	$d\delta$	= .
$-\frac{1}{3}$	9.06	$\alpha=$	h m s 23 ″ 30 ″ 01.811	$-\frac{1}{3}$	7.80	$\alpha=$	h m s 22 ″ 30 ″ 01.461
$d\alpha$ in seconds of time $=$	s. 1.811	$\delta=$	+ 0 ° 10 ′ 13.01	$d\alpha$ in seconds of time $=$	s. 1.461	$\delta=$	+ 0 ° 20 ′ 12.30

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OBSERVATORY OF HARVARD COLLEGE.

REDUCTION OF ZONES.

ZONE 20

[Form, No. 2.]

Sidereal Time	Barometer	Att. Thermometer	Ext. Thermometer
h. m.	in.	°	°
23 „ 34	30.580	62.	19.2
„ = 1 „ 30	„ = 30.610	" = 63.	" = 16.5
1 „ 54	.030		2.7

+0.30
+0.05
+0.35 for 1„54
+0.36 · 2„00

α	dα	dt	dα+dt	p	k = p − dα − dt
h. m.	s.	s.	s.	"	"
21 „ 30	+1.139	+0.000	+1.139	.	.
22 „ 30	+1.461	+0.030	+1.491	.	.
23 „ 30	+1.811	+0.060	+1.871	.	.

dτ₀ = +0.30
dτ₁ = +0.04
dτ = +0.34
ds = +2.94
ds − dτ = +2.60

α	dδ	dr′	dδ+dr′	q	d = q − dδ − dr′
h. m.	"	"	"	"	"
21 „ 30	+10.71	+0.00	+10.71	.	.
22 „ 30	+12.25	+0.18	+12.43	.	.
23 „ 30	+13.01	+0.36	+13.37	.	.

dδ 12.25
dδ′ 12.30
dδ − dδ′ = −0.05

d = (dδ − dδ′) − (ds − dτ) = −2.65

Change of k for +10′ in Dec. = + 0.014 s.

Change of d for +10′ in Dec. = −2.65 "

δ = ° ′ "	δ = ° ′ "	δ = ° ′ "	δ = ° ′ "
α	k	k	d	d
h. m.	s.	s.	"	"
„	.	.	.	.
„	.	.	.	.
„	.	.	.	.
„	.	.	.	.
„	.	.	.	.
„	.	.	.	.
„	.	.	.	.
„	.	.	.	.
„	.	.	.	.
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„	.	.	.	.
„	.	.	.	.
„	.	.	.	.

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1853phae.proj..25

Dec. 15, 1852

Best of da & $d\delta$

α Aquarii

Mean R	21h 58m 10.755s	Dec.	−1° 02′ 13.13″
App.	21h 58m 12.05s		−1° 02′ 02.0″
	da +1.293s		$d\delta$ +11.13″
Comp.	da 1.296	Comp.	$d\delta$ +11.16

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Wone 20

Observed December 15, 1852

	f	g	G	h	H	i				
Dec. 11	+27.36	+11.92	1°25′	+20.37	9°00′	+1.39	α	21h30m	322°30′	δ +0°10′
" 16	28.19	12.28	1°18′	20.41	4°19′	+0.67	α′	22h30m	337°30′	
" 15	+28.03	+12.21	1°19′	+20.40	5°05′	+0.81	α′	23h30m	352°30′	

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OBSERVATORY OF HARVARD COLLEGE.

REDUCTION OF ZONES.

ZONE 21 (Observed Dec. 22

[Form, No. 1.]

H	358 43	$=i$	
α	322 30	cos. δ	
$H+\alpha$	321 13	c'	$=-0.19$
sin. $(H+\alpha)$	9.79684	cos. $(H+\alpha)$	9.89183
sec. δ	0.00000	sin. δ	7.46373
$=h$	1.31006	h	1.31006
b	1.10690 $=-12.79$	b'	8.66562 $=+0.05$
G	1 03		
$G+\alpha$	323 33		
sin. $(G+\alpha)$	9.77387	cos. $(G+\alpha)$	9.90546
tan. δ	7.46373		
$=g$	1.10415	g	1.10415
a	8.34175 $=-0.02$	a'	1.00961 $=+10.23$
	$f=+29.20$		$+10.09$
	26.39	$d\delta$	$=$
$d\alpha$ in seconds of arc	$=+16.39$		h m s
	$-\frac{1}{3}$ 5.46	α	$=21\ 30\ 01.093$
$d\alpha$ in seconds of time	s. $=+1.093$	δ	$=+0\ 10\ 10.09$

H	358 43	$=i$	9.27875
α	337 30	cos. δ	
$H+\alpha$	336 13	c'	9.27874 $=-0.19$
sin. $(H+\alpha)$	9.60561	cos. $(H+\alpha)$	9.96146
sec. δ	0.00000	sin. δ	7.46373
$=h$	1.31006	h	1.31006
b	0.91567 $=-8.23$	b'	8.73525 $=+0.05$
G	1 03		
$G+\alpha$	338 33		
sin. $(G+\alpha)$	9.56311	cos. $(G+\alpha)$	9.96883
tan. δ	7.46373		
$=g$	1.10415	g	1.10415
a	8.13099 $=-0.01$	a'	1.07298 $=+11.83$
	$f=+29.20$		11.69
	$+20.96$	$d\delta$	$=$
$d\alpha$ in seconds of arc	$=+20.96$		h m s
	$-\frac{1}{3}$ 6.98	α	$=22\ 30\ 01.398$
$d\alpha$ in seconds of time	s. $=+1.398$	δ	$=+0\ 10\ 10.69$

H	358 43	$=i$	
α	352 30	cos. δ	
$H+\alpha$	351 13	c'	$=-0.19$
sin. $(H+\alpha)$	9.18383	cos. $(H+\alpha)$	9.99488
sec. δ	0.00000	sin. δ	7.46373
$=h$	1.31006	h	1.31006
b	0.49389 $=-3.12$	b'	8.76867 $=+0.06$
G	1 03		
$G+\alpha$	353 33		
sin. $(G+\alpha)$	9.05052	cos. $(G+\alpha)$	9.99724
tan. δ	7.46373		
$=g$	1.10415	g	1.10415
a	7.61840 $=-0.00$	a'	1.10139 $=+12.63$
	$f=+29.20$		12.50
	26.08	$d\delta$	$=$
$d\alpha$ in seconds of arc	$=+26.08$		h m s
	$-\frac{1}{3}$ 8.69	α	$=23\ 30\ 01.74$
$d\alpha$ in seconds of time	s. $=+1.740$	δ	$=+0\ 10\ 12.50$

H	358 43	$=i$	9.27875
α	337 30	cos. δ	9.99999
$H+\alpha$	336 13	c'	9.27874 $=-0.19$
sin. $(H+\alpha)$	9.60561	cos. $(H+\alpha)$	9.96146
sec. δ	0.00001	sin. δ	7.46475
$=h$	1.31006	h	1.31006
b	0.91568 $=-8.23$	b'	8.73627 $=+0.11$
G	1 03		
$G+\alpha$	338 33		
sin. $(G+\alpha)$	9.56311	cos. $(G+\alpha)$	9.96883
tan. δ	7.46476		
$=g$	1.10415	g	1.10415
a	8.43202 $=-0.03$	a'	1.07298 $=+11.83$
	$f=+29.20$		$+11.75$
	20.94	$d\delta$	$=$
$d\alpha$ in seconds of arc	$=+20.94$		h m s
	$-\frac{1}{3}$ 6.98	α	$=22\ 30\ 01.396$
$d\alpha$ in seconds of time	s. $=+1.396$	δ	$=+0\ 20\ 11.75$

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OBSERVATORY OF HARVARD COLLEGE.

REDUCTION OF ZONES.

ZONE 21 [Form, No. 2.]

Sidereal Time	Barometer	Att. Thermometer	Ext. Thermometer
h. m.	in.	°	°
23 „ 58	30.666	58.	13.1
„ = 1 „ 58	„ = 30.740	" = 62.	" = 12.8
2 „ 00	0.074		0.3

″
+0.03
+ .13
+0.16 for 2 h

α	dα	dt	dα+dt	p	k = p − dα − dt
h. m.	s.	s.	s.	″	″
21 „ 30	+1.093	+0.000	+1.093	.	.
22 „ 30	+1.398	+0.040	+1.438	.	.
23 „ 30	+1.740	+0.080	+1.820	.	.

$d\alpha_0 = +0.30$
$d\alpha' = +0.07$
$d\alpha = +0.37$
$ds = +3.14$
$ds - d\alpha = +2.77$

α	dδ	dr′	dδ+dr′	q	d = q − dδ − dr′
h. m.	″	″	″	″	″
21 „ 30	+10.09	+0.00	+10.09	.	.
22 „ 30	11.69	+0.08	+11.77	.	.
23 „ 30	12.50	+0.16	+12.66	.	.

$d\delta_0 = 11.69$
$d\delta' = 11.75$
$d\delta - d\delta' = -0.06$
$(ds - d\alpha) - (d\delta - d\delta') = -2.83$

Change of k for +10′ in Dec. = s. .

Change of d for +10′ in Dec. = ″ −2.83

δ = ° ′ ″	δ = ° ′ ″	δ = ° ′ ″	δ = ° ′ ″

α	k	k	d	d
h. m.	s.	s.	″	″
„	.	.	.	.
„	.	.	.	.
„	.	.	.	.
„	.	.	.	.
„	.	.	.	.
„	.	.	.	.
„	.	.	.	.
„	.	.	.	.
„	.	.	.	.
„	.	.	.	.
„	.	.	.	.
„	.	.	.	.
„	.	.	.	.

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Dec. 22, 1852

Test of da & dδ

α Aquarii

Mean	R	21h 58m 10.755s	Dec. − 1° 2′ 13.13″
App.	"	5s 12.00	1. 2′ 2.5″
		da +1.245s	+10.63

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Wone 21

Observed December 22, 1852

	f	g	G	h	H	i			
			° ′	″	° ′	″	h m	° ′	
Dec. 21	+29.03	+12.64	1 06	+20.42	359 39	−0.05	21 30	322 30	δ+0 10
26	+29.87	+13.01	0 50	+20.40	354 59	−0.78	22 30	337 30	
22	+29.20	+12.71	1 03	+20.42	358 43	−0.19	23 30	352 30	

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OBSERVATORY OF HARVARD COLLEGE.

REDUCTION OF ZONES.

ZONE 22 Observed Dec. 29

[FORM, No. 1.]

H	352° 09′	″ $=i$	
α	345° 00	cos. δ	
$H+\alpha$	337° 09	c'	$=-1.21$
sin. $(H+\alpha)$	9.58919	cos. $(H+\alpha)$	9.96451
sec. δ	0.00000	sin. δ	09
″ $=h$	1.30920	h	1.
b	0.89839 $=-7.91$	b'	$=$
G	0° 39′		
$G+\alpha$	345° 39		
sin. $(G+\alpha)$	.	cos. $(G+\alpha)$	9.98623
tan. δ	. ∞	g	1.12156
″ $=g$	.	a'	1.10779 $=+12.82$
a	$=$		$+11.61$
	$f=+30.38$	$d\delta$	$=$
	22.47		
$d\alpha$ in seconds of arc	$=+22.49$	$\alpha=$	° ′ ″
	$-\frac{1}{3}$ 7.49		
$d\alpha$ in seconds of time	s. $=+1.498$	$\delta=$	

H	352° 09′	″ $=i$	
α	360° 00	cos. δ	
$H+\alpha$	352° 09	c'	$=-1.21$
sin. $(H+\alpha)$	9.13539	cos. $(H+\alpha)$	.
sec. δ	0.00000	sin. δ	∞
″ $=h$	1.30920	h	.
b	0.44459 $=-2.78$	b'	$=$
G	0° 39′		
$G+\alpha$	0° 39		
sin. $(G+\alpha)$	.	cos. $(G+\alpha)$	9.99997
tan. δ	. ∞	g	1.12156
″ $=g$	.	a'	1.12153 $=+13.23$
a	$=$		$+12.02$
	$f=+30.38$	$d\delta$	$=$
	27.60		
$d\alpha$ in seconds of arc	$=+27.60$	$\alpha=$	° ′ ″
	$-\frac{1}{3}$ 9.20		
$d\alpha$ in seconds of time	s. $=+1.840$	$\delta=$	

H	352° 09′	″ $=i$	
α	15° 00	cos. δ	
$H+\alpha$	7° 09	c'	$=-1.21$
sin. $(H+\alpha)$	9.09506	cos. $(H+\alpha)$	.
sec. δ	0.00000	sin. δ	∞
″ $=h$	1.30920	h	.
b	0.40426 $=+2.54$	b'	$=$
G	0° 39′		
$G+\alpha$	15° 39		
sin. $(G+\alpha)$	.	cos. $(G+\alpha)$	9.98859
tan. δ	. ∞	g	1.12156
″ $=g$	.	a'	1.10515 $=+12.74$
a	$=$		11.53
	$f=+30.38$	$d\delta$	$=$
	32.92		
$d\alpha$ in seconds of arc	$=+32.92$	$\alpha=$	° ′ ″
	$-\frac{1}{3}$ 10.97		
$d\alpha$ in seconds of time	s. $=2.195$	$\delta=$	

H	352° 09′	″ $=i$	
α	360° 00	cos. δ	
$H+\alpha$	352° 09	c'	$=-1.21$
sin. $(H+\alpha)$	9.13539	cos. $(H+\alpha)$	9.99691
sec. δ	0.00000	sin. δ	7.46373
″ $=h$	1.30920	h	1.30921
b	0.44459 $=-2.78$	b'	8.76885 $=+0.06$
G	0° 39′		
$G+\alpha$	0° 39		
sin. $(G+\alpha)$	8.05478	cos. $(G+\alpha)$	9.99997
tan. δ	7.46393	g	1.12156
″ $=g$	1.12156	a'	1.12153 $=+13.23$
a	6.64007 $=$ 0.6		$+12.05$
	$f=+30.38$	$d\delta$	$=$
$d\alpha$ in seconds of arc	$=+27.60$	$\alpha=$	° ′ ″
	$-\frac{1}{3}$ 9.20		
$d\alpha$ in seconds of time	s. $=+1.840$	$\delta=$	

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OBSERVATORY OF HARVARD COLLEGE.

REDUCTION OF ZONES.

ZONE 22 [Form, No. 2.]

Sidereal Time = 0h 46m	Barometer = 30.118 in.	Att. Thermometer = 62.°	Ext. Thermometer = 34.5°
" = 2h 21m	" = 30.160	" = 61.	" = 33.6
1m 35s	0.042		9

+0.10
+0.07
0.19 for 1m 35s
+0.22 " 2m 00s
$d\gamma$ +0.30
$d\alpha$ +0.03
$d\alpha$ = +0.34
$d\delta$ = +2.01
$d\delta - d\alpha$ = +1.67
$d\delta$ 12.02
$d\delta'$ 12.08
$d\delta - d\delta'$ = 0.06
$d = (d\delta - d\delta') - (d\delta - d\alpha)$ = −1.73

α h. m.	$d\alpha$ s.	dt s.	$d\alpha + dt$ s.	p "	$k = p - d\alpha - dt$ "
23h 00m	+1.498	+0.000	+1.498	.	.
0h 00m	+1.840	+0.054	1.894	.	.
1h 00m	+2.195	+0.108	1.303	.	.

α h. m.	$d\delta$ "	dr' "	$d\delta + dr'$ "	q "	$d = q - d\delta - dr'$ "
23h 00m	+11.61	+0.00	+11.61	.	.
0h 00m	+12.02	+0.11	+12.13	.	.
1h 00m	+11.53	+0.22	+11.75	.	.

Change of k for +10′ in Dec. = s. .

Change of d for +10′ in Dec. = " −1.73

	δ = ° ′ "	δ = ° ′ "	δ = ° ′ "	δ = ° ′ "
α h. m.	k s.	k s.	d "	d "
"	.	.	.	.
"	.	.	.	.
"	.	.	.	.
"	.	.	.	.
"	.	.	.	.
"	.	.	.	.
"	.	.	.	.
"	.	.	.	.
"	.	.	.	.
"	.	.	.	.
"	.	.	.	.
"	.	.	.	.
"	.	.	.	.

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Wone 22

Observed December 29, 1852

	f	g	G	h	H	i			
Dec. 26	+29.87	+18.01	0°.50′	+20.40	354°.69′	−0.78	23h.00m	345°.00′	8+0°.00′
" 31	+30.70	+13.37	0.31	+20.36	350.17	−1.50	24.00	= 360.00	
" 29	+30.38	+13.23	0.89	+20.38	352.09	−1.21	1.00	15.00	

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OBSERVATORY OF HARVARD COLLEGE.

REDUCTION OF ZONES.

ZONE 23 *Observed Jan. 5, 1853*

[Form, No. 1.]

H	345° 34′	H	345° 34′
α	345° 00	α	00° 00
$H+\alpha$	330° 34	$H+\alpha$	345° 34
sin. $(H+\alpha)$	$9^n.69144$	sin. $(H+\alpha)$	$9^n.39664$
sec. δ	0.00000	sec. δ	0.00000
$=h$	1.30750	$=h$	1.30750
b	$0^n.99894 = -9.98$	b	$0^n.70414 = -5.06$
G	179° 43′	G	179° 43′
$G+\alpha$	164° 43′	$G+\alpha$	179° 43′
sin. $(G+\alpha)$	.	sin. $(G+\alpha)$	.
tan. δ	. ∞	tan. δ	. ∞
$=g$	.	$=g$	.
a	. = .	a	. = .
	$f = -14.64$		$f = -14.64$
	-24.72		-19.70
$d\alpha$ in seconds of arc	$= -24.72$	$d\alpha$ in seconds of arc	$= -19.70$
	$-\frac{1}{3}$ 8.24		$-\frac{1}{3}$ 6.57
$d\alpha$ in seconds of time	s. $= -1.648$	$d\alpha$ in seconds of time	s. $= -1.313$

$=i$	.	$=i$	.
cos. δ	.	cos. δ	.
c'	$= -2.19$	c'	$= -2.19$
cos. $(H+\alpha)$	.	cos. $(H+\alpha)$	.
sin. δ	. ∞	sin. δ	. ∞
h	.	h	.
b'	. = .	b'	. = .
cos. $(G+\alpha)$	$9^n.98436$	cos. $(G+\alpha)$	$9^n.99999$
g	0.80414	g	0.80414
a'	$0^n.78850 = -6.14$	a'	$0^n.80413 = -6.37$
	-8.33		-8.56
$d\delta$	= .	$d\delta$	= .
α	= h m 22 58.352	α	= ° ′ ″
δ	= − 0 ″ 00 ″ 08.33	δ	=

H	345° 34′	H	345° 34′
α	15° 00	α	″
$H+\alpha$	0° 34	$H+\alpha$	345° 34
sin. $(H+\alpha)$	7.99520	sin. $(H+\alpha)$	$9^n.39664$
sec. δ	0.00000	sec. δ	0.00000
$=h$	1.30750	$=h$	1.30750
b	$9.30270 = +0.20$	b	$0^n.70414 = -5.06$
G	179° 43′	G	179° 43′
$G+\alpha$	194° 43′	$G+\alpha$	179° 43′
sin. $(G+\alpha)$	9.2	sin. $(G+\alpha)$	7.69417
tan. δ	7.46373	tan. δ	7.46373
$=g$	0.80413	$=g$	0.80413
a	6.96203 = .	a	. = .
	$f = -14.64$		$f = -14.64$
	-14.44		-19.70
$d\alpha$ in seconds of arc	$= -14.44$	$d\alpha$ in seconds of arc	$= .$
	$-\frac{1}{3}$ 4.81		$-\frac{1}{3}$.
$d\alpha$ in seconds of time	s. $= -0.963$	$d\alpha$ in seconds of time	s. $= .$

$=i$	.	$=i$	.
cos. δ	.	cos. δ	.
c'	$= -2.19$	c'	$= -2.19$
cos. $(H+\alpha)$	.	cos. $(H+\alpha)$	$9^n.98607$
sin. δ	. ∞	sin. δ	7.46373
h	.	h	1.30750
b'	. = .	b'	$8.75730 = +0.06$
cos. $(G+\alpha)$	$9^n.98557$	cos. $(G+\alpha)$	$9^n.99999$
g	0.80414	g	0.80414
a'	$0^n.78965 = -6.16$	a'	$0^n.80413 = -6.37$
	-8.35		-8.50
$d\delta$	= .	$d\delta$	= .
α	= ° ′ ″	α	= ° ′ ″
δ	=	δ	=

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OBSERVATORY OF HARVARD COLLEGE.

REDUCTION OF ZONES.

ZONE 23 [Form, No. 2.]

Sidereal Time = 1h 23m	Barometer = 30.140 in.	Att. Thermometer = 60.°	Ext. Thermometer = 21.5°
" = 3h 18m	" = 30.160	" = 63.	" = 18.7
1h 55m	.020		2.8

α h. m.	dα s.	dt s.	dα+dt s.	p "	k = p − dα − dt "
23h 00m	+1.648	+0.000	−1.648	.	.
0h 00m	−1.313	+0.059	−1.254	.	.
1h 00m	+0.963	+0.118	−0.845	.	.

α h. m.	dδ "	dr' "	dδ+dr' "	q "	d = q − dδ − dr' "
23h 00m	−8.33	+0.00	−8.33	.	.
0h 00m	−8.56	+0.18	−8.38	.	.
1h 00m	−8.38	+0.36	−7.99	.	.

Change of k for +10′ in Dec. = s. .

Change of d for +10′ in Dec. = −2".53

δ = ° ′ "	δ = ° ′ "	δ = ° ′ "	δ = ° ′ "	
α h. m.	k s.	k s.	d "	d "
"	.	.	.	.
"	.	.	.	.
"	.	.	.	.
"	.	.	.	.
"	.	.	.	.
"	.	.	.	.
"	.	.	.	.
"	.	.	.	.
"	.	.	.	.
"	.	.	.	.
"	.	.	.	.
"	.	.	.	.
"	.	.	.	.

+0.31
0.04
+0.35 per 1h 55m
0.36 " 2h 00m
dγ = +0.30
dγ' = +0.05
dr = +0.35
ds = +2.82
ds − dγ = +2.47
dδ −8.56
dδ' −8.50
dδ − dδ' = −0.06
d = (dδ − dδ') − (ds − dγ) − 2.53

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Zone 23

Observed Jan. 5, 1853

	f	g	G	h	H	i			
			° ′		° ′		h m	° ′	° ′
Jan. 1	−15″.29	+6″.66	179 06	+20″.35	349 21	−1″.63	23 00	345 00	8+0 00
" 6	−14.48	+6.30	179 52	+20.29	344 38	−2.33	1 00	15 00	
" 5	−14.64	+6.37	179 43	+20.30	345 34	−2.19			

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OBSERVATORY OF HARVARD COLLEGE.

REDUCTION OF ZONES.

ZONE 24 Observed Jan. 6, 1853

[Form, No. 1.]

H	344° 38′		
α	352° 30		
$H+\alpha$	337° 08		
sin. $(H+\alpha)$	9.55949	cos. $(H+\alpha)$	9.96445
sec. δ	0.00000	sin. δ	7.46373
$=h$	1.30728	h	1.30728
b	0.89677 = +7.88	b'	8.73546 = +0.05
G	179° 52′		
$G+\alpha$	172° 22		
sin. $(G+\alpha)$	9.12331	cos. $(G+\alpha)$	9.99613
tan. δ	7.46373		
$=g$	0.79934	g	0.79934
a	7.38638 = +0.00	a'	0.79547 = −6.24
	f = −14.48		−8.52
$d\alpha$ in seconds of arc =	−22.36	$d\delta$ =	
$-\frac{1}{3}$	7.45	α =	
$d\alpha$ in seconds of time =	s. −1.491	δ =	

H	344° 38′		
α	7° 30		
$H+\alpha$	352° 08		
sin. $(H+\alpha)$	9.13630	cos. $(H+\alpha)$	9.99589
sec. δ	0.00000	sin. δ	7.46373
$=h$	1.30728	h	1.30728
b	0.44358 = −2.78	b'	8.76690 = +0.06
G	179° 52′		
$G+\alpha$	187° 22		
sin. $(G+\alpha)$	9.10796	cos. $(G+\alpha)$	9.99640
tan. δ	7.46373		
$=g$	0.79934	g	0.79934
a	7.37102 = −0.00	a'	0.79574 = +6.25
	f = −14.48		−8.52
$d\alpha$ in seconds of arc =	−17.26	$d\delta$ =	
$-\frac{1}{3}$	5.75	α =	
$d\alpha$ in seconds of time =	s. 1.151	δ =	

H	344° 38′		
α	22° 30		
$H+\alpha$	7° 08		
sin. $(H+\alpha)$	9.09405	cos. $(H+\alpha)$	9.99664
sec. δ	0.00000	sin. δ	7.46373
$=h$	1.30728	h	1.30728
b	0.40133 = +2.52	b'	8.76765 = +0.06
G	179° 52′		
$G+\alpha$	202° 22		
sin. $(G+\alpha)$	9.58039	cos. $(G+\alpha)$	9.96603
tan. δ	7.46373		
$=g$	0.79934	g	0.79934
a	7.84346 = −0.01	a'	0.76537 = −5.83
	f = −14.48		8.10
$d\alpha$ in seconds of arc =	−11.97	$d\delta$ =	
$-\frac{1}{3}$	3.99	α =	
$d\alpha$ in seconds of time =	s. −0.798	δ =	

H	344° 38′		
α	7° 30		
$H+\alpha$	352° 08		
sin. $(H+\alpha)$	9.13630	cos. $(H+\alpha)$	9.99589
sec. δ	0.00001	sin. δ	7.76476
$=h$	1.30728	h	1.30728
b	0.44359 = −2.78	b'	8.06792 = +0.12
G	179° 52′		
$G+\alpha$	187° 22		
sin. $(G+\alpha)$	9.10796	cos. $(G+\alpha)$	9.99640
tan. δ	7.76476		
$=g$	0.79934	g	0.79934
a	7.67205 = −0.01	a'	0.79574 = +6.25
	f = −14.48		8.46
$d\alpha$ in seconds of arc =	−17.27	$d\delta$ =	
$-\frac{1}{3}$		α =	
$d\alpha$ in seconds of time =	s.	δ =	

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OBSERVATORY OF HARVARD COLLEGE.

REDUCTION OF ZONES.

ZONE 24

[Form, No. 2.]

Sidereal Time = 1 h. 14 m.
" = 3 " 08
1.54

Barometer = 30.000 in.
" = 29.994
.006

Att. Thermometer = 55. °
" = 52.

Ext. Thermometer = 27.8 °
" = 27.0
8

α h. m.	$d\alpha$ s.	dt s.	$d\alpha+dt$ s.	p "	$k=p-d\alpha-dt$ "
23 " 30	.	+0.000	.	.	.
0 " 30	.	+0.055	.	.	.
1 " 30	.	+0.110	.	.	.

α h. m.	$d\delta$ "	dr' "	$d\delta+dr'$ "	q "	$d=q-d\delta-dr'$ "
23 " 30	.	+0.00	.	.	.
0 " 30	.	+0.00	.	.	.
1 " 30	.	+0.08	.	.	.

Change of k for $+10'$ in Dec. = . s.

Change of d for $+10'$ in Dec. = -2.15 "

α h. m.	$\delta =$ ° ' "	k s.	$\delta =$ ° ' "	k s.	$\delta =$ ° ' "	d "	$\delta =$ ° ' "	d "
"		.		.		.		.
"		.		.		.		.
"		.		.		.		.
"		.		.		.		.
"		.		.		.		.
"		.		.		.		.
"		.		.		.		.
"		.		.		.		.
"		.		.		.		.
"		.		.		.		.
"		.		.		.		.
"		.		.		.		.
"		.		.		.		.

-0.01
$+.09$
$dr = +0.08$
$dr_0 = +0.30$
$dr' = +0.04$
$dr = +0.34$
$ds = +2.43$
$ds - dr = +2.09$
$d\delta_1 = -8.52$
$d\delta = -8.46$
$d\delta - d\delta' = -0.06$
$d = (ds - d\delta) - (ds - dr) = -2.15$

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Wone 24

Observed Jan. 6, 1853

	f	g	G	h	H	i			
Jan. 6	−1".48	+6".30	179° 52′	+20".29	344° 38′	−2".33	α	23° 30 = 352° 30′	δ +0° 10′
							α	0° 30	7° 30
							α	1° 30	22° 30

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OBSERVATORY OF HARVARD COLLEGE.

REDUCTION OF ZONES.

ZONE 25 Observed Jan. 7, 1853

[Form, No. 1.]

H	343° 41′		
α	352° 30		
$H+\alpha$	336° 11		
sin. $(H+\alpha)$	9.60618	cos. $(H+\alpha)$	9.96135
sec. δ	0.00000	sin. δ	7.46373
$=h$	1.30685	h	1.30685
b	0.91303 = −8.18	v	8.73193 = +0.05
G	180° 04		
$G+\alpha$	172° 34		
sin. $(G+\alpha)$	9.11184	cos. $(G+\alpha)$	9.99633
tan. δ	7.46373		
$=g$	0.79449	g	0.79449
a	8.37006 = +0.02	a'	0.79082 = −6.18
f	−14.32		−8.60
	22.50	$d\delta$	=
$d\alpha$ in seconds of arc	= −22.50		
	−⅓ 7.50	α	=
$d\alpha$ in seconds of time	= −1.500 s.	δ	=

H	343° 41′		
α	7° 30		
$H+\alpha$	351° 11		
sin. $(H+\alpha)$	9.18547	cos. $(H+\alpha)$	9.99484
sec. δ	0.00000	sin. δ	7.46373
$=h$	1.30685	h	1.30685
b	0.49232 = −3.11	v	8.76542 = +0.06
G	180° 04		
$G+\alpha$	187° 34		
sin. $(G+\alpha)$	9.11952	cos. $(G+\alpha)$	9.99620
tan. δ	7.46373		
$=g$	0.79449	g	0.79449
a	7.37774 = 0.00	a'	0.79069 = −6.18
f	−14.32		−8.59
	17.43	$d\delta$	=
$d\alpha$ in seconds of arc	= 17.43		
	−⅓ 5.81	α	=
$d\alpha$ in seconds of time	= −1.162 s.	δ	=

H	343° 41′		
α	22° 30		
$H+\alpha$	6° 11		
sin. $(H+\alpha)$	9.03226	cos. $(H+\alpha)$	9.99747
sec. δ	0.00000	sin. δ	7.46373
$=h$	1.30685	h	1.30685
b	0.33911 = +2.18	v	8.76805 = +0.06
G	180° 04		
$G+\alpha$	202° 34		
sin. $(G+\alpha)$	9.58406	cos. $(G+\alpha)$	9.96541
tan. δ	7.46373		
$=g$	0.79449	g	0.79449
a	7.84228 = −0.01	a'	0.75990 = −5.57
f	−14.32		−7.98
	12.15	$d\delta$	=
$d\alpha$ in seconds of arc	= −12.15		
	−⅓ 4.05	α	=
$d\alpha$ in seconds of time	= −0.810 s.	δ	=

H	343° 41′		
α	7° 30		
$H+\alpha$	351° 11		
sin. $(H+\alpha)$	9.18549	cos. $(H+\alpha)$	9.99484
sec. δ	0.00001	sin. δ	7.86475
$=h$	1.30685	h	1.30685
b	0.49233 = −3.11	v	9.06644 = +0.12
G	180° 04		
$G+\alpha$	187° 34		
sin. $(G+\alpha)$	9.11952	cos. $(G+\alpha)$	9.99620
tan. δ	7.76476		
$=g$	0.79449	g	0.79449
a	7.67877 = −0.00	a'	0.79069 = −6.18
f	−14.32		−8.63
	−17.43	$d\delta$	=
$d\alpha$ in seconds of arc	=		
	−⅓	α	=
$d\alpha$ in seconds of time	= s.	δ	=

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OBSERVATORY OF HARVARD COLLEGE.

REDUCTION OF ZONES.

ZONE 25

[Form, No. 2.]

Sidereal Time = 1h 51m	Barometer = 29.964 in.	Att. Thermometer = 62. °	Ext. Thermometer = 36.8 °
" = 3h 53m	" = 30.000	" = 57.	" = 35.8
	.036		1.0

α h. m.	$d\alpha$ s.	dt s.	$d\alpha + dt$ s.	p "	$k = p - d\alpha - dt$ "
23h 30m	−1.500	+0.000	.	.	.
0h 30m	−1.162	+0.060	.	.	.
1h 30m	−0.810	+0.120	.	.	.

α h. m.	$d\delta$ "	dr' "	$d\delta + dr'$ "	q "	$d = q - d\delta - dr'$ "
23h 30m	−8.60	+0.00	.	.	.
0h 30m	−8.59	+0.08	.	.	.
1h 30m	−7.98	+0.17	.	.	.

Change of k for $+10'$ in Dec. =	s. .
Change of d for $+10'$ in Dec. =	" −1.58

δ = ° ′ "	δ = ° ′ "	δ = ° ′ "	δ = ° ′ "	
α	k	k	d	d
h. m.	s.	s.	"	"
"	.	.	.	.
"	.	.	.	.
"	.	.	.	.
"	.	.	.	.
"	.	.	.	.
"	.	.	.	.
"	.	.	.	.
"	.	.	.	.
"	.	.	.	.
"	.	.	.	.
"	.	.	.	.
"	.	.	.	.
"	.	.	.	.

" +0.06 +0.11 +0.17

$dr'_0 = +0.30$
$dr' = +0.08$
$dr = +0.38$
$ds = +1.40$
$ds - dr = +1.52$
$d\delta = -8.59$
$d\delta' = -8.53$
$d\delta - d\delta' = -0.06$
$d = (d\delta - d\delta') - (ds - dr) - 1.58$

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Mone 25

Observed Jan. 7, 1853

	f	g	G	h	H	i			
Jan 6	−14·48	+6·30	179°52′	+20·29	344°38′	−2·33	a 23h 30m	352°30′	δ +0°10′
11	−13·68	+5·96	180°51′	+20·20	339°52′	3·02	0h 30m	7°30′	
7	−14·32	+6·23	180°04′	+20·27	343°41′	−2·49	1h 30m	22°30′	

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OBSERVATORY OF HARVARD COLLEGE.

REDUCTION OF ZONES.

ZONE 26 Observed Jan. 8, 1853

[Form, No. 1.]

H	342° 44′	$=i$	
α	7° 30	$\cos\delta$	
$H+\alpha$	350° 14	c'	$=-2.61$
$\sin(H+\alpha)$	9.22952	$\cos(H+\alpha)$	9.99366
$\sec\delta$	0.00000	$\sin\delta$	∞
$=h$	1.30643	h	1.30643
b	0.53595 $=-3.43$	b'	$=$
G	180° 16		
$G+\alpha$	187° 46		
$\sin(G+\alpha)$		$\cos(G+\alpha)$	9.99600
$\tan\delta$	∞		
$=g$		g	0.78958
a	$=$	a'	0.78558 $=-6.10$
	$f=-14.16$		-8.71
	-17.59	$d\delta$	$=$
$d\alpha$ in seconds of arc $=$	-17.59		
	$-\frac{1}{3}$ -5.86	$\alpha=$	″
$d\alpha$ in seconds of time $=$	s. -1.173	$\delta=$	

H	342° 44′	$=i$	
α	22° 30	$\cos\delta$	
$H+\alpha$	5° 14	c'	$=-2.61$
$\sin(H+\alpha)$	8.96003	$\cos(H+\alpha)$	
$\sec\delta$	0.00000	$\sin\delta$	∞
$=h$	1.30643	h	
b	0.26648 $=1.85$	b'	$=$
G	180° 16		
$G+\alpha$	202° 46		
$\sin(G+\alpha)$		$\cos(G+\alpha)$	9.96477
$\tan\delta$	∞		
$=g$		g	0.78958
a	$=$	a'	0.75435 $=-5.64$
	$f=-14.16$		-8.29
	-12.31	$d\delta$	$=$
$d\alpha$ in seconds of arc $=$	-12.31		
	$-\frac{1}{3}$ 4.10	$\alpha=$	″
$d\alpha$ in seconds of time $=$	s. -0.821	$\delta=$	

H	342° 44′	$=i$	
α	37° 30	$\cos\delta$	
$H+\alpha$	20° 14	c'	$=-2.61$
$\sin(H+\alpha)$	9.53888	$\cos(H+\alpha)$	
$\sec\delta$	0.00006	$\sin\delta$	∞
$=h$	1.30643	h	
b	0.84531 $=7.00$	b'	$=$
G	180° 16		
$G+\alpha$	217° 46		
$\sin(G+\alpha)$		$\cos(G+\alpha)$	9.89791
$\tan\delta$	∞		
$=g$		g	0.78558
a	$=$	a'	0.68349 $=-4.82$
	$f=-14.16$		-7.43
	-7.16	$d\delta$	$=$
$d\alpha$ in seconds of arc $=$	-7.16		
	$-\frac{1}{3}$ -2.39	$\alpha=$	″
$d\alpha$ in seconds of time $=$	s. -0.477	$\delta=$	

H	342° 44′	$=i$	
α	22° 30	$\cos\delta$	
$H+\alpha$	5° 14	c'	$=-2.61$
$\sin(H+\alpha)$	8.96005	$\cos(H+\alpha)$	9.99819
$\sec\delta$	0.00000	$\sin\delta$	7.46373
$=h$	1.30643	h	1.30643
b	0.26648 $=1.85$	b'	8.76835 $=0.06$
G	180° 16		
$G+\alpha$	202° 46		
$\sin(G+\alpha)$	9.98769	$\cos(G+\alpha)$	9.96477
$\tan\delta$	7.46373		
$=g$	0.78958	g	0.78958
a	7.84100 $=-0.01$	a'	0.76435 $=-5.68$
	$f=-14.16$		8.23
	12.32	$d\delta$	$=$
$d\alpha$ in seconds of arc $=$	-12.32		
	$-\frac{1}{3}$ 4.11	$\alpha=$	″
$d\alpha$ in seconds of time $=$	s. -0.821	$\delta=$	

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OBSERVATORY OF HARVARD COLLEGE.

REDUCTION OF ZONES.

ZONE 26 [Form, No. 2.]

Sidereal Time = 1h 47m	Barometer = 30.238 in.	Att. Thermometer = 63.°	Ext. Thermometer = 37.°4
" = 3h 43m	" = 30.250	" = 62.	" = 33.2
1h 56m	012		4.2

α h. m.	dα s.	dt s.	dα+dt s.	p "	k = p − dα − dt "
0h 30m	−1.173	+0.000	.	.	.
1h 30m	−0.821	+0.060	.	.	.
2h 30m	−0.479	+0.120	.	.	.

α h. m.	dδ "	dr' "	dδ+dr' "	q "	d = q − dδ − dr' "
0h 30m	−8.71	0.00	.	.	.
1h 30m	−8.24	0.24	.	.	.
2h 30m	−7.43	0.48	.	.	.

+0.02
+0.46
+0.48

$dr'_0 = +0.30$
$dr' = +0.01$
$dr = +0.31$
$ds = +1.97$
$ds - dr = +1.66$
$d\delta = -8.25$
$d\delta' = -8.23$
$d\delta - d\delta' = -0.06$
$d = (d\delta - d\delta') - (ds + dr) = +1.72$

Change of k for $+10'$ in Dec. = s. .

Change of d for $+10'$ in Dec. = " .

	δ = ° ′ "	δ = ° ′ "	δ = ° ′ "	δ = ° ′ "
α h. m.	k s.	k s.	d "	d "
"	.	.	.	.
"	.	.	.	.
"	.	.	.	.
"	.	.	.	.
"	.	.	.	.
"	.	.	.	.
"	.	.	.	.
"	.	.	.	.
"	.	.	.	.
"	.	.	.	.
"	.	.	.	.
"	.	.	.	.
"	.	.	.	.
"	.	.	.	.

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Hone 26

Observed January 8, 1853

	f	g	G	h	H	i		
Jan. 6	−14.48	+6.30	179° 52′	+20.29	344° 38′	−2.33	00h 30 = 7° 30′	8 + 00° 00 to + 0° 10
" 11	13.68	+5.96	180° 51	+20.20	339° 52	−3.02	1 30	22 30
8	−14.16	+6.16	180° 16	+20.25	342° 44	−2.61	2 30	37 30

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OBSERVATORY OF HARVARD COLLEGE.

REDUCTION OF ZONES.

ZONE 27 Observed Jan. 11, 1853

[Form, No. 1.]

H	335° 52′	$''. = i$.	
α	7″ 30	cos. δ .	
$H+\alpha$	347″ 22	c'	$= -3.02$
sin. $(H+\alpha)$	9.33987	cos. $(H+\alpha)$.	
$''$ sec. δ	0.00000	sin. δ .	∞
$''. = h$	1.30535	h .	
b	0.64522 $= -4.42$	b' .	$=$.
G	180° 51′		
$G+\alpha$	188° 21		
sin. $(G+\alpha)$.		cos. $(G+\alpha)$	9.99537
$''$ tan. δ	∞	g	0.77525
$''. = g$.		a'	$0.77062 = -5.90$
a .	$=$.		-8.92
$f = -13.68$		$d\delta$	$=$.
	18.10		
$d\alpha$ in seconds of arc	$= -18.10$	$\alpha =$	° ′ ″
$-\frac{1}{3}$	6.03		
s.			
$d\alpha$ in seconds of time	$= -1.207$	$\delta =$	

H	339° 52′	$''. = i$.	
α	22″ 30	cos. δ .	
$H+\alpha$	2″ 22	c'	$= -3.02$
sin. $(H+\alpha)$	8.61589	cos. $(H+\alpha)$.	
$''$ sec. δ	0.00000	sin. δ .	∞
$''. = h$	1.30535	h .	
b	9.92124 $= 0.83$	b' .	$=$.
G	180° 51′		
$G+\alpha$	203° 21		
sin. $(G+\alpha)$.		cos. $(G+\alpha)$	9.96289
$''$ tan. δ	∞	g	0.77525
$''. = g$.		a'	$0.73814 = -5.47$
a .	$=$.		-8.49
$f = -13.68$		$d\delta$	$=$.
	-12.85		
$d\alpha$ in seconds of arc	$= -12.85$	$\alpha =$	° ′ ″
$-\frac{1}{3}$	4.28		
s.			
$d\alpha$ in seconds of time	$= -0.857$	$\delta =$	

H	339° 52′	$''. = i$.	
α	37″ 30	cos. δ .	
$H+\alpha$	17″ 22	c' .	$= -3.02$
sin. $(H+\alpha)$	9.47492	cos. $(H+\alpha)$.	
$''$ sec. δ	0.00000	sin. δ .	∞
$''. = h$	1.30535	h .	
b	0.78027 $= 6.03$	b' .	$=$.
G	180° 51′		
$G+\alpha$	218° 21		
sin. $(G+\alpha)$.		cos. $(G+\alpha)$	9.89445
$''$ tan. δ	∞	g	0.77525
$''. = g$.		a'	$0.66970 = -4.67$
a .	$=$.		7.69
$f = -13.68$		$d\delta$	$=$.
	7.65		
$d\alpha$ in seconds of arc	$= -7.65$	$\alpha =$	° ′ ″
$-\frac{1}{3}$	2.55		
s.			
$d\alpha$ in seconds of time	$= -0.510$	$\delta =$	

H	339° 52′	$''. = i$.	
α	22″ 30	cos. δ .	
$H+\alpha$	2″ 22	c'	$= -3.02$
sin. $(H+\alpha)$	8.61589	cos. $(H+\alpha)$	9.99963
$''$ sec. δ	0.00000	sin. δ	7.46375
$''. = h$	1.30535	h	1.30535
b	9.92124 $=$.	b'	$8.76873 = 0.06$
G	180° 51′		
$G+\alpha$	203° 21		
sin. $(G+\alpha)$	9.59808	cos. $(G+\alpha)$	9.96289
$''$ tan. δ	9.46373		
$''. = g$	0.77525	g	0.77525
a	9.83906 $=$.	a'	$0.73814 = -5.49$
$f =$.			-8.45
		$d\delta$	$=$.
$d\alpha$ in seconds of arc	$=$.	$\alpha =$	° ′ ″
$-\frac{1}{3}$	.		
s.			
$d\alpha$ in seconds of time	$=$.	$\delta =$	

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OBSERVATORY OF HARVARD COLLEGE.

REDUCTION OF ZONES.

ZONE 27

[Form, No. 2.]

Sidereal Time	Barometer	Att. Thermometer	Ext. Thermometer
h. m.	in.	°	°
2 „ 48	29.860	69.	29.4
„ = 4 „ 40	„ = 29.840	" = 69.	" = 27.3
1 „ 52	.020		2.1

α	dα	dt	dα+dt	p	k = p − dα − dt
h. m.	s.	s.	s.	"	"
0 „ 30	−1.207	+0.000	.	.	.
1 „ 30	−0.857	+0.067	.	.	.
2 „ 30	−0.510	+0.134	.	.	.

α	dδ	dr'	dδ+dr'	q	d = q − dδ − dr'
h. m.	"	"	"	"	"
0 „ 30	−8.92	0.000	.	.	.
1 „ 30	−8.49	0.006	.	.	.
2 „ 30	−7.69	0.000	.	.	.

Change of k for +10′ in Dec. = s. .

Change of d for +10′ in Dec. = " −2.09

−0.04
+0.04
dr' 0.00
"
dr'0 +0.30
dr' +0.04
dr' = +0.34
ds = +2.39
ds − dr = +2.05
dδ = −8.49
dδ' = −8.45
dδ − dδ' = −0.04
d = (dδ − dδ') − (ds − dr) = −2.09

δ = ° ′ " | δ = ° ′ " | δ = ° ′ " | δ = ° ′ "

α	k	k	d	d
h. m.	s.	s.	"	"
„	.	.	.	.
„	.	.	.	.
„	.	.	.	.
„	.	.	.	.
„	.	.	.	.
„	.	.	.	.
„	.	.	.	.
„	.	.	.	.
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„	.	.	.	.
„	.	.	.	.

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Phone 27

Observed Jan. 11/1853

	f	g	G	h	H	i	h m	° ′	
Jan. 11	−13·68	+6·96	180° 51′	+20·20	339° 52′	−3·02	00h 30m	= 7° 30′	δ = +00° 00′
" 15							1h 30m	22° 30′	(to 0° 10′
" 11							2h 30m	37° 30′	

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OBSERVATORY OF HARVARD COLLEGE.

REDUCTION OF ZONES.

ZONE 28 *Observed* Jan. 21, 1853

[FORM, No. 1.]

H	330° 13′	$\cdot = i \cdot$	
α	15° 00	cos. δ 0.00000	
$H+\alpha$	345° 13	c'	$= -4.30$
sin. $(H+\alpha)$	9.40682	cos. $(H+\alpha)$	9.98538
sec. δ	0.00000	sin. δ	7.46373
$\cdot = h$	1.30016	h	1.30016
b	0.70698 $= -5.09$	b'	8.74927 $= 0.06$
G	183° 33′		
$G+\alpha$	198° 33		
sin. $(G+\alpha)$	9.50261	cos. $(G+\alpha)$	9.97683
tan. δ	7.46373		
$\cdot = g$	0.72509	g	0.72509
a	7.69141 $= -0.00$	a'	0.70192 $= -5.03$
	$f = -12.17$		-9.27
	17.26	$d\delta$	= .
$d\alpha$ in seconds of arc	$= -17.26$		° ′
$-\frac{1}{3}$	5.75	α	= ″
$d\alpha$ in seconds of time	s. $= -1.151$	δ	= .

H	330° 13′	$\cdot = i \cdot$	
α	30° 00	cos. δ	
$H+\alpha$	0° 13	c'	$= -4.30$
sin. $(H+\alpha)$	7.57767	cos. $(H+\alpha)$	0.00000
sec. δ	0.00000	sin. δ	7.46373
$\cdot = h$	1.30016	h	1.30016
b	8.87783 $= 0.07$	b'	8.76389 $= 0.06$
G	183° 33′		
$G+\alpha$	213° 33		
sin. $(G+\alpha)$	9.74246	cos. $(G+\alpha)$	9.92086
tan. δ	7.46373		
$\cdot = g$	0.72509	g	0.72509
a	7.93128 $= -0.01$	a'	0.64595 $= -4.42$
	$f = -12.17$		-6.66
	12.11	$d\delta$	= .
$d\alpha$ in seconds of arc	$= -12.11$		° ′
$-\frac{1}{3}$	4.04	α	= ″
$d\alpha$ in seconds of time	s. $= -0.707$	δ	=

H	330° 13′	$\cdot = i \cdot$	
α	45° 00	cos. δ	
$H+\alpha$	15° 13	c'	$= -4.30$
sin. $(H+\alpha)$	9.41908	cos. $(H+\alpha)$	9.98450
sec. δ	0.00000	sin. δ	7.46373
$\cdot = h$	1.30016	h	1.30016
b	0.71024 $= 5.13$	b'	8.74839 $= 0.06$
G	183° 33′		
$G+\alpha$	198° 33		
sin. $(G+\alpha)$	9.50261	cos. $(G+\alpha)$	9.97683
tan. δ	7.46373		
$\cdot = g$	0.72509	g	0.72509
a	7.69143 $= -0.00$	a'	0.70192 $= -5.03$
	$f = -12.17$		-9.27
	7.04	$d\delta$	= .
$d\alpha$ in seconds of arc	$= -7.04$		° ′
$-\frac{1}{3}$	2.35	α	= ″
$d\alpha$ in seconds of time	s. $= -0.469$	δ	=

H	330° 13′	$\cdot = i \cdot$	
α	30° 00	cos. δ	
$H+\alpha$	0° 13	c'	$= -4.30$
sin. $(H+\alpha)$	7.57767	cos. $(H+\alpha)$	0.00000
sec. δ	0.00000	sin. δ	7.76445
$\cdot = h$	1.30016	h	1.30016
b	8.87784 $= +0.07$	b'	9.06461 $= +0.12$
G	183° 33′		
$G+\alpha$	213° 33		
sin. $(G+\alpha)$	9.74246	cos. $(G+\alpha)$	9.92086
tan. δ	7.76476		
$\cdot = g$	0.72509	g	0.72509
a	8.23221 $= -0.02$	a'	0.64595 $= -4.42$
	$f = -12.17$		-8.60
	12.12	$d\delta$	= .
$d\alpha$ in seconds of arc	$= -12.12$		° ′
$-\frac{1}{3}$	4.04	α	= ″
$d\alpha$ in seconds of time	s. $= -0.808$	δ	=

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OBSERVATORY OF HARVARD COLLEGE.

REDUCTION OF ZONES.

ZONE 28

[Form, No. 2.]

Sidereal Time = 2 h. 55 m.
" = 4 " 5.0
1.55

Barometer = 29.868 in.
" = 30.020
.052

Att. Thermometer = 62.°
" = 62.

Ext. Thermometer = 27.9°
" = 25.2
2.7

α h. m.	$d\alpha$ s.	dt s.	$d\alpha+dt$ s.	p "	$k=p-d\alpha-dt$ "
1 " 00	.	+0.000	.	.	.
2 " 00	.	+0.067	.	.	.
3 " 00	.	+0.134	.	.	.

+0.09
+0.30
$dr' = +0.39$
$dr_0 = +0.30$
$dr' = +0.09$
dr +0.39
ds +2.49
$ds-dr$ +2.15

α h. m.	$d\delta$ "	dr' "	$d\delta+dr'$ "	q "	$d=q-d\delta-dr'$ "
1 " 00	.	+0.00	.	.	.
2 " 00	.	+0.19	.	.	.
3 " 00	.	+0.39	.	.	.

$d\delta$ −8.66
$d\delta_1$ −8.60
$d\delta-d\delta' = -0.06$

$d=(d\delta-d\delta')-(ds-ds')=-2.21$

Change of k for +10′ in Dec. = . s.

Change of d for +10′ in Dec. = −2.21 "

α h. m.	$\delta =$ ° ′ "	k s.	$\delta =$ ° ′ "	k s.	$\delta =$ ° ′ "	d "	$\delta =$ ° ′ "	d "
"		.		.		.		.
"		.		.		.		.
"		.		.		.		.
"		.		.		.		.
"		.		.		.		.
"		.		.		.		.
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"		.		.		.		.
"		.		.		.		.
"		.		.		.		.

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Mone 28

Observed Jan. 21, 1853

	f	g	G	h	H	i
Jan. 21	−12·17	+5·31	183°..33′	+19·96	330°..13′	−4·30

a 1..00 = 15°..00 8+0..10′ to 0°..20′
2..00 30°..00
3..00 45°..00

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OBSERVATORY OF HARVARD COLLEGE.

REDUCTION OF ZONES.

ZONE 29 Observed Jan. 29. 1852

[Form, No. 1.]

H	322 ° 20 ′	$= i$		322 ° 20 ′	$= i$
α	15 ° 00	$\cos\delta$		30 ° 00	$\cos\delta$
$H+\alpha$	337 ° 20	c'	$= -5.24$	352 ° 20	c' $= -5.24$
$\sin(H+\alpha)$	$9^n.58588$	$\cos(H+\alpha)$	9.96509	$9^n.72519$	$\cos(H+\alpha)$ 9.99610
sec. δ	0.00000	$\sin\delta$	7.46373	0.00000	$\sin\delta$ 7.46373
$= h$	1.29535	h	1.29535	1.29535	h 1.29535
b	$0.88123 = -7.61$	b'	$8.72417 = +0.05$	$0.42054 = -2.63$	b' $8.75518 = +0.06$
G	186 ° 27 ′			186 ° 27 ′	
$G+\alpha$	201 ° 27			216 ° 27	
$\sin(G+\alpha)$	$9^n.56388$	$\cos(G+\alpha)$	$9^n.96883$	$9^n.77387$	$\cos(G+\alpha)$ 9.90546
tan. δ	7.46373			7.46373	
$= g$	0.68574	g	0.68574	0.68574	g 0.68574
a	$7^n.71260 = -0.00$	a'	$0^n.65457 = -4.51$	$7.92334 = -0.00$	a' $0.59120 = -3.40$
	$f = -11.06$		-9.80	$f = -11.06$	9.08
	-18.67	$d\delta$	$=$.	-13.69	$d\delta$ $=$.
$d\alpha$ in seconds of arc	$= -18.67$		° ′	$d\alpha$ in seconds of arc $= -13.69$	° ′
	$-\frac{1}{3}$ 6.22	$\alpha =$	″	$-\frac{1}{3}$ 4.57	$\alpha =$ ″
$d\alpha$ in seconds of time	s. $= -1.245$	$\delta =$		s. $d\alpha$ in seconds of time $= -0.912$	$\delta =$

H	322 ° 20 ′	$= i$		322 ° 20 ′	$= i$
α	45 ° 00	$\cos\delta$		30 ° 00	$\cos\delta$
$H+\alpha$	7 ° 20	c'	$= -5.24$	352 ° 20	c' $= -5.24$
$\sin(H+\alpha)$	9.10599	$\cos(H+\alpha)$	9.99643	$9^n.72519$	$\cos(H+\alpha)$ 9.99610
sec. δ	0.00000	$\sin\delta$	7.46373	0.00000	$\sin\delta$ 7.76475
$= h$	1.29535	h	1.29535	1.29535	h 1.29535
b	$0.40134 = +2.52$	b'	$8.75551 = +0.06$	$0.42054 = -2.63$	b' $9.05620 = +0.11$
G	186 ° 27 ′			186 ° 27 ′	
$G+\alpha$	231 ° 27			216 ° 27	
$\sin(G+\alpha)$	$9^n.89324$	$\cos(G+\alpha)$	$9^n.79463$	$9^n.77387$	$\cos(G+\alpha)$ 9.90546
tan. δ	7.46373			7.76476	
$= g$	0.68574	g	0.68574	0.68574	g 0.68574
a	$8^n.04271 = -0.01$	a'	$0^n.48037 = -3.02$	$8.22437 = -0.02$	a' $0^n.59120 = -3.81$
	$f = -11.06$		-8.20	$f = -11.06$	-8.94
	-8.55	$d\delta$	$=$.	-13.71	$d\delta$ $=$.
$d\alpha$ in seconds of arc	$= -8.55$		° ′	$d\alpha$ in seconds of arc $= -13.71$	° ′
	$-\frac{1}{3}$ 2.85	$\alpha =$	″	$-\frac{1}{3}$.	$\alpha =$ ″
$d\alpha$ in seconds of time	s. $= -0.570$	$\delta =$		s. $d\alpha$ in seconds of time $=$.	$\delta =$

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OBSERVATORY OF HARVARD COLLEGE.

REDUCTION OF ZONES.

ZONE 29

[Form, No. 2.]

Sidereal Time = 3 h. 18 m.	Barometer = 30.126 in.	Att. Thermometer = 61. °	Ext. Thermometer = 25.8 °
" = 5 h. 08 m.	" = 30.050	" = 58.	" = 26.3
1.50	.076	3	0.5

α h. m.	$d\alpha$ s.	dt s.	$d\alpha + dt$ s.	p "	$k = p - d\alpha - dt$ "
1 h. 00 m.	.	+0.000	.	.	.
2 h. 00 m.	.	+0.060	.	.	.
3 h. 00 m.	.	+0.120	.	.	.

α h. m.	$d\delta$ "	dr' "	$d\delta + dr'$ "	q "	$d = q - d\delta - dr'$ "
1 h. 00 m.	.	−0.00	.	.	.
2 h. 00 m.	.	−0.00	.	.	.
3 h. 00 m.	.	−0.29	.	.	.

Change of k for $+10'$ in Dec. = s. .	Change of d for $+10'$ in Dec. = " −2.30

δ = ° ′ "	δ = ° ′ "	δ = ° ′ "	δ = ° ′ "

α h. m.	k s.	k s.	d "	d "
"	.	.	.	.
"	.	.	.	.
"	.	.	.	.
"	.	.	.	.
"	.	.	.	.
"	.	.	.	.
"	.	.	.	.
"	.	.	.	.
"	.	.	.	.
"	.	.	.	.
"	.	.	.	.
"	.	.	.	.
"	.	.	.	.

−0.14
− .05
$dr' = -0.19$
$2^h = -0.21$
$d\delta_0 = +0.30$
$d\delta r = +0.05$
dr +0.35
ds +2.51
$ds - dr$ + 2.16
$d\delta$ −4.08
$d\delta'$ −8.54
$d\delta - d\delta'$ −0.14
− 2.30

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Done 29

Observed Jan. 29, 1853

	f	g	G	h	H	i	
Jan. 26	−11.46	+5.01	185°17′	+19.82	325°18′	−4.89	a = 1ʰ00ᵐ = 15°00′ δ = +0°10′ to +0°20′
31	−10.78	+4.73	187°15′	+19.68	320°20′	−5.46	2°00 = 30°00
29	−11.06	4.85	186°27′	+19.74	322°20′	−5.24	3°00 = 45°00

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OBSERVATORY OF HARVARD COLLEGE.

REDUCTION OF ZONES.

ZONE 30 Observed Feb. 1st

[Form, No. 1.]

H	319° 20′	$=i$	
α	37° 30′	cos. δ	
$H+\alpha$	356° 50′	c'	$=-5''.56$
sin. $(H+\alpha)$	8.74226	cos. $(H+\alpha)$	9.99934
sec. δ	0.00000	sin. δ	∞
$=h$	1.29336	h	1.29336
b	0.03562 $=-1''.08$	b'	1.29270 $=$
G	187° 41′		
$G+\alpha$	225° 11′		
sin. $(G+\alpha)$	9.85087	cos. $(G+\alpha)$	9.84809
tan. δ	∞		
$=g$	0.67025	g	0.67025
a	$=$	a'	0.51834 $=-3.30$
	$f=-10.65$		-8.86
$d\alpha$ in seconds of arc	$=-11.73$	$d\delta$	$=$
	$-\frac{1}{3}$ 3.91	$\alpha=$	° ′ ″
$d\alpha$ in seconds of time	s. $=-0.782$	$\delta=$	

H	319° 20′	$=i$	
α	52° 30′	cos. δ	
$H+\alpha$	11° 50′	c'	$=-5''.56$
sin. $(H+\alpha)$	9.31189	cos. $(H+\alpha)$	9.99067
sec. δ	0.00000	sin. δ	∞
$=h$	1.29336	h	1.29336
b	0.60525 $=+4''.03$	b'	$=$
G	187° 41′		
$G+\alpha$	240° 11′		
sin. $(G+\alpha)$	9.93833	cos. $(G+\alpha)$	9.96955
tan. δ	∞		
$=g$		g	0.67025
a	$=$	a'	0.36680 $=-2.33$
	$f=-10.65$		-7.89
	-6.62		
$d\alpha$ in seconds of arc	$=-6.62$	$d\delta$	$=$
	$-\frac{1}{3}$ 2.21	$\alpha=$	° ′ ″
$d\alpha$ in seconds of time	s. $=-0.441$	$\delta=$	

H	319° 20′	$=i$	
α	67° 30′	cos. δ	
$H+\alpha$	26° 50′	c'	$=-5''.56$
sin. $(H+\alpha)$	9.65456	cos. $(H+\alpha)$	9.99052
sec. δ	0.00000	sin. δ	∞
$=h$	1.29336	h	
b	0.94792 $=+8''.87$	b'	$=$
G	187° 41′		
$G+\alpha$	255° 11′		
sin. $(G+\alpha)$	9.98531	cos. $(G+\alpha)$	9.40778
tan. δ	∞		
$=g$		g	0.67025
a	$=$	a'	0.07803 $=-1.20$
	$f=-10.65$		-6.76
	-1.78		
$d\alpha$ in seconds of arc	$=-1.78$	$d\delta$	$=$
	$-\frac{1}{3}$ .59	$\alpha=$	° ′ ″
$d\alpha$ in seconds of time	s. $=-0.119$	$\delta=$	

H	319° 20′	$=i$	
α	52° 30′	cos. δ	
$H+\alpha$	11° 50′	c'	$=-5''.56$
sin. $(H+\alpha)$	9.31189	cos. $(H+\alpha)$	9.99067
sec. δ	0.00000	sin. δ	7.46373
$=h$	1.29336	h	1.29336
b	0.60525 $=+4''.03$	b'	8.75776 $=+0''.06$
G	187° 41′		
$G+\alpha$	240° 11′		
sin. $(G+\alpha)$	9.93833	cos. $(G+\alpha)$	9.96955
tan. δ	7.46373		
$=g$	0.67025	g	0.67025
a	7.07231 $=-0.00$	a'	0.36680 $=-2.33$
	$f=-10.65$		-7.83
	-6.62		
$d\alpha$ in seconds of arc	$=-6.62$	$d\delta$	$=$
	$-\frac{1}{3}$ 2.21	$\alpha=$	° ′ ″
$d\alpha$ in seconds of time	s. $=-0.441$	$\delta=$	

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OBSERVATORY OF HARVARD COLLEGE.

REDUCTION OF ZONES.

ZONE 30

[Form, No. 2.]

Sidereal Time = 3 h. 27 m.
" = 7 " 27
2..00

Barometer = 30·548 in.
" = 30·534
·014

Att. Thermometer = 60·0°
" = 58·

Ext. Thermometer = 25·0°
" = 20·2
4·8

" −0.02
+ ·53
dr = 0·51

α h. m.	dα s.	dt s.	dα+dt s.	p "	k = p − dα − dt "
2 "30	·	+0·000	·	·	·
3 "30	·	+0·060	·	·	·
4 "30	·	+0.120	·	·	·

α h. m.	dδ "	dr' "	dδ+dr' "	q "	d = q − dδ − dr' "
2 "30	·	+0·00	·	·	·
3 "30	·	+0·25	·	·	·
4 "30	·	+0·51	·	·	·

Change of k for +10′ in Dec. = s. ·

Change of d for +10′ in Dec. = " ·

δ = ° ′ " | δ = ° ′ " | δ = ° ′ " | δ = ° ′ "

α h. m.	k s.	k s.	d "	d "
"	·	·	·	·
"	·	·	·	·
"	·	·	·	·
"	·	·	·	·
"	·	·	·	·
"	·	·	·	·
"	·	·	·	·
"	·	·	·	·
"	·	·	·	·
"	·	·	·	·
"	·	·	·	·
"	·	·	·	·
"	·	·	·	·

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Wone 30

Observed Feb. 1, 1852

	f	g	G	h	H	i		
Jan. 31	−10·78	+4·73	187°15′	+19·68	320°20′	−5″·46	2h 30m	= 37°30′
Feb. 5	−10·15	+4·48	189°28′	+19·53	315°17′	−5·97	3h 30m	52°30′
" 1	−10·65	+4·68	187°41′	+19·65	319°20′	−5·56	4h 30m	67°30′

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OBSERVATORY OF HARVARD COLLEGE.

REDUCTION OF ZONES.

ZONE 31 Observed Feb. 1, 1853 [Form, No. 1.]

H	319° 20′	$\cdot = i$	$\cdot$
α	63° 45′	cos. δ	$\cdot$
$H+\alpha$	23° 05′	c'	$=-6''.56$
sin. $(H+\alpha)$	9.59336	cos. $(H+\alpha)$	9.96376
sec. δ	0.00000	sin. δ	∞
$\cdot = h$	1.29336	h	$\cdot$
b	0.88672 $=+7''.70$	b'	$\cdot = \cdot$
G	187° 41′		
$G+\alpha$	251° 26′		
sin. $(G+\alpha)$	9.97679	cos. $(G+\alpha)$	9.50298
tan. δ	∞		
$\cdot = g$	$\cdot$	g	0.67025
a	$\cdot = \cdot$	a'	$0^m.17323 = -1.49$
	$f=-10.65$		-7.05
	2.95	$d\delta$	$= \cdot$
$d\alpha$ in seconds of arc	$=-2.95$		
$-\frac{1}{3}$	.98	α	$=$ ° ′ ″
$d\alpha$ in seconds of time	$=-.197$ s.	δ	$=$

H	319° 20′	$\cdot = i$	$\cdot$
α	78° 45′	cos. δ	$\cdot$
$H+\alpha$	38° 05′	c'	$=-5''.56$
sin. $(H+\alpha)$	9.79015	cos. $(H+\alpha)$	9.89604
sec. δ	0.00000	sin. δ	∞
$\cdot = h$	1.29336	h	$\cdot$
b	1.08351 $=+12''.12$	b'	$\cdot = \cdot$
G	187° 41′		
$G+\alpha$	266° 26′		
sin. $(G+\alpha)$	9.99916	cos. $(G+\alpha)$	8.79386
tan. δ	∞		
$\cdot = g$	$\cdot$	g	0.67025
a	$\cdot = \cdot$	a'	$9^m.46411 = -0.29$
	$f=-10.65$		-5.83
	+1.47	$d\delta$	$= \cdot$
$d\alpha$ in seconds of arc	$=+1.47$		
$-\frac{1}{3}$	.49	α	$=$ ° ′ ″
$d\alpha$ in seconds of time	$=+.098$ s.	δ	$=$

H	319° 20′	$\cdot = i$	$\cdot$
α	93° 45′	cos. δ	$\cdot$
$H+\alpha$	53° 05′	c'	$=-5''.56$
sin. $(H+\alpha)$	9.90282	cos. $(H+\alpha)$	9.77862
sec. δ	0.00000	sin. δ	∞
$\cdot = h$	1.29336	h	$\cdot$
b	1.19618 $=+15''.71$	b'	$\cdot = \cdot$
G	187° 41′		
$G+\alpha$	281° 26′		
sin. $(G+\alpha)$	9.99130	cos. $(G+\alpha)$	9.29716
tan. δ	∞		
$\cdot = g$	$\cdot$	g	0.67025
a	$\cdot = \cdot$	a'	$9^m.96741 = -0.93$
	$f=-10.65$		-6.49
	+5.06	$d\delta$	$= \cdot$
$d\alpha$ in seconds of arc	$=+5.06$		
$-\frac{1}{3}$	169	α	$=$ ° ′ ″
$d\alpha$ in seconds of time	$=+.337$ s.	δ	$=$

H	319° 20′	$\cdot = i$	0.74507
α	78° 45′	cos. δ	0.00000
$H+\alpha$	38° 05′	c'	$=-5''.56$
sin. $(H+\alpha)$	9.79015	cos. $(H+\alpha)$	9.89604
sec. δ	0.00000	sin. δ	7.46373
$\cdot = h$	1.29336	h	1.29336
b	1.08351 $=+12''.12$	b'	8.65313 $=+0.05$
G	187° 41′		
$G+\alpha$	266° 26′		
sin. $(G+\alpha)$	8.79386	cos. $(G+\alpha)$	8.79386
tan. δ	7.46373		
$\cdot = g$	0.67025	g	0.67025
a	$6^m.92784 = -0.08$	a'	$9^m.46411 = -0.29$
	$f=-10.65$		-5.80
	+1.46	$d\delta$	$= \cdot$
$d\alpha$ in seconds of arc	$=+1.46$		
$-\frac{1}{3}$	.48	α	$=$ ° ′ ″
$d\alpha$ in seconds of time	$=+.098$ s.	δ	$=$

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OBSERVATORY OF HARVARD COLLEGE.

REDUCTION OF ZONES.

ZONE 31 [Form, No. 2.]

Sidereal Time = 5h 27m	Barometer = 30·541 in.	Att. Thermometer = 59°.	Ext. Thermometer = 22°·6
" = 7 " 27	" = 30·534	" = 58°.	" = 20°·2

α	$d\alpha$	dt	$d\alpha + dt$	p	$k = p - d\alpha - dt$
h. m.	s.	s.	s.	"	"
4 " 15`	.	.	.	.	.
5 " 15`	.	.	.	.	.
6 " 15`	.	.	.	.	.

α	$d\delta$	dr'	$d\delta + dr'$	q	$d = q - d\delta - dr'$
h. m.	"	"	"	"	"
4 " 15`	.	.	.	.	.
5 " 15`	.	.	.	.	.
6 " 15`	.	.	.	.	.

Change of k for $+10'$ in Dec. = s. . Change of d for $+10'$ in Dec. = " .

	$\delta =$ ° ′ "	$\delta =$ ° ′ "	$\delta =$ ° ′ "	$\delta =$ ° ′ "
α	k	k	d	d
h. m.	s.	s.	"	"
"	.	.	.	.
"	.	.	.	.
"	.	.	.	.
"	.	.	.	.
"	.	.	.	.
"	.	.	.	.
"	.	.	.	.
"	.	.	.	.
"	.	.	.	.
"	.	.	.	.
"	.	.	.	.
"	.	.	.	.
"	.	.	.	.

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Feb. 1st

f	g	G	h	H	i
−10·65	+4·68	187°41'	+19·65	319°20'	−5·56

h m	° '		
4h 15m =	63° 45'	δ +0°00'	to +0°10'
5h 15m =	78° 45'		
6h 15m =	93° 45'		

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OBSERVATORY OF HARVARD COLLEGE.

REDUCTION OF ZONES.

ZONE 32

[Form, No. 1.]

H	312° 13′	H	312° 13′
α	33° 45′	α	48° 45′
$H+\alpha$	345° 58′	$H+\alpha$	0° 58′
sin. $(H+\alpha)$	9.38469	sin. $(H+\alpha)$	8.22713
sec. δ	0.00000	sec. δ	0.00000
$=h$	1.28870	$=h$	1.28870
b	0.67339 $=-4.71$	b	9.51583 $=+0.33$
G	190° 55′	G	190° 55′
$G+\alpha$	224° 40′	$G+\alpha$	239° 40′
sin. $(G+\alpha)$	.	sin. $(G+\alpha)$	.
tan. δ	. ∞	tan. δ	. ∞
$=g$	0.63749	$=g$	.
a	. = .	a	. = .
	$f=-9.78$		$f=-9.78$
$d\alpha$ in seconds of arc	$=-14.49$	$d\alpha$ in seconds of arc	$=-9.45$
$-\frac{1}{3}$	4.83	$-\frac{1}{3}$	3.15
$d\alpha$ in seconds of time	$=-.966$ s.	$d\alpha$ in seconds of time	$=-.630$ s.

$=i$	.	$=i$	.
cos. δ	.	cos. δ	.
c'	$=-6.25$	c'	$=-6.25$
cos. $(H+\alpha)$	9.9	cos. $(H+\alpha)$	.
sin. δ	. ∞	sin. δ	. ∞
h	.	h	.
b'	. = .	b'	. = .
cos. $(G+\alpha)$	9.91158	cos. $(G+\alpha)$	9.70332
g	0.63749	g	0.63749
a'	0.64907 $=-3.54$	a'	0.34081 $=-2.19$
	-9.79		-8.44
$d\delta$	= .	$d\delta$	= .
α	° ′	α	° ′
	″		″
δ	=	δ	=

H	312° 13′	H	312° 13′
α	63° 45′	α	48° 45′
$H+\alpha$	15° 58′	$H+\alpha$	0° 58′
sin. $(H+\alpha)$	9.43946	sin. $(H+\alpha)$	8.22713
sec. δ	0.00000	sec. δ	0.00000
$=h$	1.28870	$=h$	1.28870
b	0.72816 $=+5.35$	b	9.51583 $=+0.33$
G	190° 55′	G	190° 55′
$G+\alpha$	254° 40′	$G+\alpha$	239° 40′
sin. $(G+\alpha)$	.	sin. $(G+\alpha)$	9.93606
tan. δ	. ∞	tan. δ	9.46373
$=g$	.	$=g$	0.63749
a	. = .	a	7.03728 $=-0.00$
	$f=-9.78$		$f=-9.78$
$d\alpha$ in seconds of arc	$=-4.43$	$d\alpha$ in seconds of arc	$=-9.45$
$-\frac{1}{3}$	1.48	$-\frac{1}{3}$	.
$d\alpha$ in seconds of time	$=-.295$ s.	$d\alpha$ in seconds of time	= . s.

$=i$	.	$=i$	.
cos. δ	.	cos. δ	.
c'	$=-6.25$	c'	$=-6.25$
cos. $(H+\alpha)$	.	cos. $(H+\alpha)$	9.99994
sin. δ	. ∞	sin. δ	7.46373
h	.	h	1.28870
b'	. = .	b'	8.75237 $=+0.06$
cos. $(G+\alpha)$	9.42232	cos. $(G+\alpha)$	9.70332
g	0.63749	g	0.63749
a'	0.05981 $=-1.15$	a'	0.34081 $=-2.19$
	-7.40		-8.38
$d\delta$	= .	$d\delta$	= .
α	° ′	α	° ′
	″		″
δ	=	δ	=

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OBSERVATORY OF HARVARD COLLEGE.

REDUCTION OF ZONES.

ZONE 32 [Form, No. 2.]

Sidereal Time = h. m. Barometer = in. Att. Thermometer = ° Ext. Thermometer = °

" = " " = . " = . " = .

α h. m.	$d\alpha$ s.	dt s.	$d\alpha+dt$ s.	p "	$k=p-d\alpha-dt$ "
2 " 15	.	.	.	.	.
3 " 15	.	.	.	.	.
4 " 15	.	.	.	.	.

α h. m.	$d\delta$ "	dr' "	$d\delta+dr'$ "	q "	$d=q-d\delta-dr'$ "
2 " 15	.	.	.	.	.
3 " 15	.	.	.	.	.
4 " 15	.	.	.	.	.

Change of k for $+10'$ in Dec. = s. .

Change of d for $+10'$ in Dec. = " .

	$\delta =$ ° ' "	$\delta =$ ° ' "	$\delta =$ ° ' "	$\delta =$ ° ' "
α h. m.	k s.	k s.	d "	d "
"	.	.	.	.
"	.	.	.	.
"	.	.	.	.
"	.	.	.	.
"	.	.	.	.
"	.	.	.	.
"	.	.	.	.
"	.	.	.	.
"	.	.	.	.
"	.	.	.	.
"	.	.	.	.
"	.	.	.	.
"	.	.	.	.

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Ydone 32

Observed Feb. 4, 1853

Feb. 5	S −10.15	g = +4.48	G 189° 28′	h +19.63	H 315° 17′	i −5.97	2h 15m	= 33° 45′	δ + 0° 00′	to + 0h 10′
10	− 9.54	4.25	191° 53′	19.38	310° 10′	−6.43	3h 15′	48° 45′		
Feb. 8	−9.78	+4.34	190 55	+19.44	312° 13′	−6.25	4h 15′	63° 45′		

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OBSERVATORY OF HARVARD COLLEGE.

REDUCTION OF ZONES.

ZONE 33

[Form, No. 1.]

H	309° 08′	$\cdot = i$	$\cdot$
α	63° 45′	$\cos\delta$	$\cdot$
$H+\alpha$	12° 53′	c'	$= -6.51$
$\sin(H+\alpha)$	9.34824	$\cos(H+\alpha)$	$\cdot$
$\sec\delta$	0.00000	$\sin\delta$	$\cdot\ \infty$
$\cdot = h$	1.28668	h	$\cdot$
b	0.63492 $= +4.31$	b'	$\cdot\ =\ \cdot$
G	192° 24′		
$G+\alpha$	256° 09′	$\cos(G+\alpha)$	9.37909
$\sin(G+\alpha)$	$\cdot$		
$\tan\delta$	$\cdot\ \infty$	g	0.62428
$\cdot = g$	$\cdot$	a'	0.00337 $= -1.01$
a	$\cdot\ =\ \cdot$		-7.52
	$f = -9.42$	$d\delta$	$=\ \cdot$
$d\alpha$ in seconds of arc	$= -5.11$		
	$-\frac{1}{3}$ 1.70	α	$=\ ^\circ\ '\ ''$
$d\alpha$ in seconds of time	$= -.341$	δ	$=$

H	309° 08′	$\cdot = i$	$\cdot$
α	78° 45′	$\cos\delta$	$\cdot$
$H+\alpha$	27° 53′	c'	$= -6.51$
$\sin(H+\alpha)$	9.66994	$\cos(H+\alpha)$	$\cdot$
$\sec\delta$	0.00000	$\sin\delta$	$\cdot\ \infty$
$\cdot = h$	1.28668	h	$\cdot$
b	0.95662 $= +9.03$	b'	$\cdot\ =\ \cdot$
G	192° 24′		
$G+\alpha$	271° 09′	$\cos(G+\alpha)$	8.30256
$\sin(G+\alpha)$	$\cdot$		
$\tan\delta$	$\cdot\ \infty$	g	0.62428
$\cdot = g$	$\cdot$	a'	8.92783 $= -0.08$
a	$\cdot\ =\ \cdot$		-6.59
	$f = -9.42$	$d\delta$	$=\ \cdot$
$d\alpha$ in seconds of arc	$= -0.37$		
	$-\frac{1}{3}$ 0.02	α	$=\ ^\circ\ '\ ''$
$d\alpha$ in seconds of time	$= -.025$	δ	$=$

H	309° 08′	$\cdot = i$	$\cdot$
α	98° 45′	$\cos\delta$	$\cdot$
$H+\alpha$	42° 53′	c'	$= -6.51$
$\sin(H+\alpha)$	9.83283	$\cos(H+\alpha)$	$\cdot$
$\sec\delta$	0.00000	$\sin\delta$	$\cdot\ \infty$
$\cdot = h$	1.28668	h	$\cdot$
b	1.11951 $= +13.17$	b'	$\cdot\ =\ \cdot$
G	192° 24′		
$G+\alpha$	286° 09′	$\cos(G+\alpha)$	9.44428
$\sin(G+\alpha)$	$\cdot$		
$\tan\delta$	$\cdot\ \infty$	g	0.62428
$\cdot = g$	$\cdot$	a'	0.06856 $= -1.17$
a	$\cdot\ =\ \cdot$		-7.68
	$f = -9.42$	$d\delta$	$=\ \cdot$
$d\alpha$ in seconds of arc	$= +3.75$		
	$-\frac{1}{3}$ 1.25	α	$=\ ^\circ\ '\ ''$
$d\alpha$ in seconds of time	$= +.250$	δ	$=$

H	309° 08′	$\cdot = i$	$\cdot$
α	78° 45′	$\cos\delta$	$\cdot$
$H+\alpha$	27° 53′	c'	$= -6.51$
$\sin(H+\alpha)$	9.66994	$\cos(H+\alpha)$	9.94640
$\sec\delta$	0.00000	$\sin\delta$	7.46373
$\cdot = h$	1.28668	h	1.28668
b	0.95662 $= +9.04$	b'	8.69681 $= +0.05$
G	192° 24′		
$G+\alpha$	271° 09′	$\cos(G+\alpha)$	8.30256
$\sin(G+\alpha)$	9.99991		
$\tan\delta$	7.46373	g	0.62428
$\cdot = g$	0.62428	a'	8.92683 $= -0.08$
a	8.08792 $= +0.01$		-6.54
	$f = -9.42$	$d\delta$	$=\ \cdot$
$d\alpha$ in seconds of arc	$= -0.37$		
	$-\frac{1}{3}$ 0.12	α	$=\ ^\circ\ '\ ''$
$d\alpha$ in seconds of time	$= -.025$	δ	$=$

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OBSERVATORY OF HARVARD COLLEGE.

REDUCTION OF ZONES.

ZONE 33

[Form, No. 2.]

Sidereal Time = h. m. / " = " Barometer = in. . / " = . Att. Thermometer = ° . / " = . Ext. Thermometer = ° . / " = .

α h. m.	$d\alpha$ s.	dt s.	$d\alpha + dt$ s.	p "	$k = p - d\alpha - dt$ "
4 " 15	.	.	.	.	.
5 " 15	.	.	.	.	.
6 " 15	.	.	.	.	.

α h. m.	$d\delta$ "	dr' "	$d\delta + dr'$ "	q "	$d = q - d\delta - dr'$ "
4 " 15	.	.	.	.	.
5 " 15	.	.	.	.	.
6 " 15	.	.	.	.	.

Change of k for $+10'$ in Dec. = s. .

Change of d for $+10'$ in Dec. = " .

α h. m.	k (δ = ° ' / ") s.	k (δ = ° ' / ") s.	d (δ = ° ' / ") "	d (δ = ° ' / ") "
"	.	.	.	.
"	.	.	.	.
"	.	.	.	.
"	.	.	.	.
"	.	.	.	.
"	.	.	.	.
"	.	.	.	.
"	.	.	.	.
"	.	.	.	.
"	.	.	.	.
"	.	.	.	.
"	.	.	.	.
"	.	.	.	.

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Phone 33

Observed Feb. 11, 1858

		f	g	G	h	H	i			
Feb.	10	−9.54	+4.25	191°53′	+19.38	310°10′	−6.43	4h 15m =	63°45′	8+0°00′ 6+0°10′
	15	8.97	4.03	194°27′	19.24	304°54′	−6.83	5h 15m =	78°45′	
	11	−9.42	+4.21	192°24′	+19.35	309°05′	−6.57	6h 15m =	93°45′	

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OBSERVATORY OF HARVARD COLLEGE.

REDUCTION OF ZONES.

ZONE 34

[Form, No. 1.]

H	308° 05′	i	0ˢ.81889
α	40° 00	cos. δ	0.00000
$H+\alpha$	348° 05′	c'	−6.″59
sin. $(H+\alpha)$	9ˢ.31490	cos. $(H+\alpha)$	9.99054
sec. δ	0.00000	sin. δ	7.46373
h	1.28601	h	1.28601
b	0.60091 = −3.″99	b'	8.74028 = +0.″05
G	192° 55′		
$G+\alpha$	232° 55′		
sin. $(G+\alpha)$	9ˢ.90187	cos. $(G+\alpha)$	9ˢ.78030
tan. δ	7.46373		
g	0.61909	g	0.61909
a	7ˢ.78469 = −0.″01	a'	0ˢ.39739 = −2.″51
	f = −9.30		−9.05
$d\alpha$ in seconds of arc	= −13.30	$d\delta$	= .
	−⅓ 4.43	α	= ° ′ ″
$d\alpha$ in seconds of time	= −ˢ.887	δ	=

H	308° 05′	i	.
α	55° 00	cos. δ	.
$H+\alpha$	3° 05′	c'	−6.″59
sin. $(H+\alpha)$	8.73069	cos. $(H+\alpha)$	9.99937
sec. δ	0.00000	sin. δ	7.46373
h	1.28601	h	1.28601
b	0.01670 = +1.″04	b'	8.74911 = +0.″06
G	192° 55′		
$G+\alpha$	247° 55′		
sin. $(G+\alpha)$	9ˢ.96691	cos. $(G+\alpha)$	9ˢ.57514
tan. δ	7.46373		
g	0.61909	g	0.61909
a	8ˢ.04973 = −0.″01	a'	0ˢ.19423 = −1.″56
	f = −9.30		−8.09
	−6.27	$d\delta$	= .
$d\alpha$ in seconds of arc	= −8.27	α	= ° ′ ″
	−⅓ 2.76	δ	=
$d\alpha$ in seconds of time	= −ˢ.551		

H	308° 05′	i	.
α	70° 00	cos. δ	.
$H+\alpha$	18° 05′	c'	−6.″59
sin. $(H+\alpha)$	9.49152	cos. $(H+\alpha)$	9.57800
sec. δ	0.00000	sin. δ	7.46373
h	1.28601	h	1.28601
b	0.77753 = +5.″99	b'	8.72774 = +0.″05
G	192° 55′		
$G+\alpha$	262° 55′		
sin. $(G+\alpha)$	9ˢ.99667	cos. $(G+\alpha)$	9ˢ.09601
tan. δ	7.46373		
g	0.61909	g	0.61909
a	8ˢ.07949 = −0.″01	a'	9ˢ.71010 = −0.″51
	f = −9.30		−7.05
$d\alpha$ in seconds of arc	= −3.32	$d\delta$	= .
	−⅓ 1.11	α	= ° ′ ″
$d\alpha$ in seconds of time	= −ˢ.221	δ	=

H	308° 05′	i	0ˢ.81889
α	55° 00	cos. δ	9.99999
$H+\alpha$	3° 05′	c'	0ˢ.81888 = −6.″59
sin. $(H+\alpha)$	8.73069	cos. $(H+\alpha)$	9.99937
sec. δ	0.00000	sin. δ	7.76475
h	1.28601	h	1.28601
b	0.01671 = +1.″04	b'	9.05013 = +0.″11
G	192° 55′		
$G+\alpha$	247° 55′		
sin. $(G+\alpha)$	9ˢ.96691	cos. $(G+\alpha)$	9ˢ.57514
tan. δ	7.76476		
g	0.61909	g	0.61909
a	8ˢ.34976 = −0.″02	a'	0.19423 = −1.″56
	f = −9.30		−8.04
$d\alpha$ in seconds of arc	= −8.28	$d\delta$	= .
	−⅓ .	α	= ° ′ ″
$d\alpha$ in seconds of time	= ˢ.	δ	=

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OBSERVATORY OF HARVARD COLLEGE.

REDUCTION OF ZONES.

ZONE 34

[Form, No. 2.]

Sidereal Time = h. m. s.
" = "

Barometer = in.
" = .

Att. Thermometer = °
" = .

Ext. Thermometer = ° .
" = .

α h. m.	$d\alpha$ s.	dt s.	$d\alpha + dt$ s.	p ″	$k = p - d\alpha - dt$ ″
2 »40	.	.	.	.	.
3 »40	.	.	.	.	.
4 »40	.	.	.	.	.

α h. m.	$d\delta$ ″	dr' ″	$d\delta + dr'$ ″	q ″	$d = q - d\delta - dr'$ ″
2 »40	.	.	.	.	.
3 »40	.	.	.	.	.
4 »40	.	.	.	.	.

Change of k for $+10'$ in Dec. = s. .

Change of d for $+10'$ in Dec. = ″ .

α h. m.	δ = ° ′ ″ : k s.	δ = ° ′ ″ : k s.	δ = ° ′ ″ : d ″	δ = ° ′ ″ : d ″
»	.	.	.	.
»	.	.	.	.
»	.	.	.	.
»	.	.	.	.
»	.	.	.	.
»	.	.	.	.
»	.	.	.	.
»	.	.	.	.
»	.	.	.	.
»	.	.	.	.
»	.	.	.	.
»	.	.	.	.
»	.	.	.	.

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Wone 34

Observed Feb. 12, 1853

	f	g	G	h	H	i	L −		
Feb. 10	−9".54	+4".25	191°53'	+19".38	310°10'	−6".43	2h40m =	40°00'	δ+0°10' b+0°20'
" 15	−8.97	+4.03	194°27'	+19.24	304°59'	−6.83	3h40m	55°00'	
12	−9.30	+4.16	192°55'	+19.32	308°05'	−6.59	4h40m	70°00'	

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OBSERVATORY OF HARVARD COLLEGE.

REDUCTION OF ZONES.

ZONE 35

[Form, No. 1.]

H	306° 01′	″ $= i$	.
α	40″ 00	cos. δ	.
$H+\alpha$	346° 01′	c'	= ″ .
sin. $(H+\alpha)$	9.98317	cos. $(H+\alpha)$	9.98694
″ sec. δ	0.00000	sin. δ	9.46373
″ $= h$	1.28488	h	1.28488
b	0.66905 = ″ .	b'	8.73555 = .
G	193° 56′		
$G+\alpha$	233° 56′		
sin. $(G+\alpha)$	9.90759	cos. $(G+\alpha)$	9.76991
″ tan. δ	9.46373		
″ $= g$	0.60959	g	0.60959
a	. = .	a'	. = .
$f = -9.09$			
		$d\delta$	= .
$d\alpha$ in seconds of arc =	.		
$-\frac{1}{3}$	.	α =	° ′ ″
$d\alpha$ in seconds of time =	s. .	δ =	

H	306° 01′	″ $= i$	.
α	55″ 00	cos. δ	.
$H+\alpha$	1° 01′	c'	= ″ .
sin. $(H+\alpha)$	8.24903	cos. $(H+\alpha)$	9.99993
″ sec. δ	0.00000	sin. δ	9.46373
″ $= h$	1.28488	h	1.28488
b	. = ″ .	b'	8.74854 = +0.056
G	193° 56′		
$G+\alpha$	248° 56′		
sin. $(G+\alpha)$	9.96996	cos. $(G+\alpha)$	9.55564
″ tan. δ	9.46373		
″ $= g$	0.60959	g	0.60959
a	. = .	a'	. = .
$f = -9.09$			
		$d\delta$	= .
$d\alpha$ in seconds of arc =	.		
$-\frac{1}{3}$	.	α =	° ′ ″
$d\alpha$ in seconds of time =	s. .	δ =	

H	306° 01′	″ $= i$	.
α	70″ 00	cos. δ	.
$H+\alpha$	16° 01′	c'	= ″ .
sin. $(H+\alpha)$	9.44078	cos. $(H+\alpha)$	9.98281
″ sec. δ	0.00000	sin. δ	9.46373
″ $= h$	1.28488	h	1.28488
b	. = ″ .	b'	. = .
G	193° 56′		
$G+\alpha$	263° 56′		
sin. $(G+\alpha)$	9.99756	cos. $(G+\alpha)$	9.02402
″ tan. δ	0.46373		
″ $= g$	0.60959	g	0.60959
a	. = .	a'	. = .
$f = -9.09$			
		$d\delta$	= .
$d\alpha$ in seconds of arc =	.		
$-\frac{1}{3}$	.	α =	° ′ ″
$d\alpha$ in seconds of time =	s. .	δ =	

H	306° 01′	″ $= i$	.
α	65″ 00	cos. δ	.
$H+\alpha$	1° 01′	c'	= ″ .
sin. $(H+\alpha)$	8.24903	cos. $(H+\alpha)$	9.99993
″ sec. δ	0.00001	sin. δ	9.46473
″ $= h$	1.28488	h	1.28488
b	. = ″ .	b'	. = .
G	193° 56′		
$G+\alpha$	248° 56′		
sin. $(G+\alpha)$	9.96996	cos. $(G+\alpha)$	9.55564
″ tan. δ	9.46476		
″ $= g$	0.60959	g	0.60957
a	. = .	a'	. = .
$f = -9.09$			
		$d\delta$	= .
$d\alpha$ in seconds of arc =	.		
$-\frac{1}{3}$	.	α =	° ′ ″
$d\alpha$ in seconds of time =	s. .	δ =	

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OBSERVATORY OF HARVARD COLLEGE.

REDUCTION OF ZONES.

ZONE 35`

[Form, No. 2.]

Sidereal Time = h. m.
" = "

Barometer = in.
" = .

Att. Thermometer = °
" = .

Ext. Thermometer = °
" = .

α	$d\alpha$	dt	$d\alpha + dt$	p	$k = p - d\alpha - dt$
h. m.	s.	s.	s.	"	"
"	.	.	.	.	.
"	.	.	.	.	.
"	.	.	.	.	.

α	$d\delta$	dr'	$d\delta + dr'$	q	$d = q - d\delta - dr'$
h. m.	"	"	"	"	"
"	.	.	.	.	.
"	.	.	.	.	.
"	.	.	.	.	.

Change of k for $+10'$ in Dec. = s.

Change of d for $+10'$ in Dec. = "

δ = ° ' "	δ = ° ' "	δ = ° ' "	δ = ° ' "
.	.	.	.

α	k	k	d	d
h. m.	s.	s.	"	"
"	.	.	.	.
"	.	.	.	.
"	.	.	.	.
"	.	.	.	.
"	.	.	.	.
"	.	.	.	.
"	.	.	.	.
"	.	.	.	.
"	.	.	.	.
"	.	.	.	.
"	.	.	.	.
"	.	.	.	.

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Ylone 35

Observed Feb. 14, 1853

	f	g	G	h	H	i	h m		
Feb. 10	−9".54	+4".25	191°.53	+19".38	310°.10	−6.43	2h 40m =	40°.00	δ = +0°.10 to +0°.20
16	−8.97	4.03	194°.27	+19.24	304°.59	−6.83	3h 40m =	55°.00	
14	−9.09	+4.07	193°.56	+19.27	306°.01	−6.75	4h 40m =	70°.00	

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OBSERVATORY OF HARVARD COLLEGE.

REDUCTION OF ZONES.

ZONE [Form, No. 2.]

Time = h. m. Barometer = in. Att. Thermometer = ° Ext. Thermometer = °

" = " " = . " = . " = .

α h. m.	$d\alpha$ s.	dt s.	$d\alpha + dt$ s.	p "	$k = p - d\alpha - dt$ "
"	.	.	.	.	.
"	.	.	.	.	.
"	.	.	.	.	.

α h. m.	$d\delta$ "	dr' "	$d\delta + dr'$ "	q "	$d = q - d\delta - dr'$ "
"	.	.	.	.	.
"	.	.	.	.	.
"	.	.	.	.	.

Change of k for $+10'$ in Dec. = s. .

Change of d for $+10'$ in Dec. = " .

δ = ° ' "	δ = ° ' "	δ = ° ' "	δ = ° ' "

α h. m.	k s.	k s.	d "	d "
"	.	.	.	.
"	.	.	.	.
"	.	.	.	.
"	.	.	.	.
"	.	.	.	.
"	.	.	.	.
"	.	.	.	.
"	.	.	.	.
"	.	.	.	.
"	.	.	.	.
"	.	.	.	.
"	.	.	.	.
"	.	.	.	.

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OBSERVATORY OF HARVARD COLLEGE.

REDUCTION OF ZONES.

ZONE [Form, No. 2.]

Sidereal Time = h. m. Barometer = in. Att. Thermometer = ° Ext. Thermometer = °

" = " " = . " = . " = .

α	$d\alpha$	dt	$d\alpha+dt$	p	$k=p-d\alpha-dt$
h. m.	s.	s.	s.	"	"
"	.	.	.	.	.
"	.	.	.	.	.
"	.	.	.	.	.

α	$d\delta$	dr'	$d\delta+dr'$	q	$d=q-d\delta-dr'$
h. m.	"	"	"	"	"
"	.	.	.	.	.
"	.	.	.	.	.
"	.	.	.	.	.

Change of k for $+10'$ in Dec. = s. .

Change of d for $+10'$ in Dec. = " .

δ = ° ' " δ = ° ' " δ = ° ' " δ = ° ' "

α	k	k	d	d
h. m.	s.	s.	"	"
"	.	.	.	.
"	.	.	.	.
"	.	.	.	.
"	.	.	.	.
"	.	.	.	.
"	.	.	.	.
"	.	.	.	.
"	.	.	.	.
"	.	.	.	.
"	.	.	.	.
"	.	.	.	.
"	.	.	.	.
"	.	.	.	.

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OBSERVATORY OF HARVARD COLLEGE.

REDUCTION OF ZONES.

ZONE [Form, No. 2.]

Sidereal Time = h. m. Barometer = in. Att. Thermometer = ° Ext. Thermometer = °

" = " " = . " = . " = .

α h. m.	$d\alpha$ s.	dt s.	$d\alpha+dt$ s.	p "	$k=p-d\alpha-dt$ "
"	.	.	.	.	.
"	.	.	.	.	.
"	.	.	.	.	.

α h. m.	$d\delta$ "	dr' "	$d\delta+dr'$ "	q "	$d=q-d\delta-dr'$ "
"	.	.	.	.	.
"	.	.	.	.	.
"	.	.	.	.	.

Change of k for $+10'$ in Dec. = s. .

Change of d for $+10'$ in Dec. = " .

δ = ° '	δ = ° '	δ = ° '	δ = ° '	
"	"	"	"	
α h. m.	k s.	k s.	d "	d "
"	.	.	.	.
"	.	.	.	.
"	.	.	.	.
"	.	.	.	.
"	.	.	.	.
"	.	.	.	.
"	.	.	.	.
"	.	.	.	.
"	.	.	.	.
"	.	.	.	.
"	.	.	.	.
"	.	.	.	.
"	.	.	.	.

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OBSERVATORY OF HARVARD COLLEGE.

REDUCTION OF ZONES.

ZONE 40

[Form, No. 1.]

H	° ′ ″	i	
α	″	cos. δ	
$H+\alpha$	″	c'	=
sin. $(H+\alpha)$		cos. $(H+\alpha)$	
sec. δ		sin. δ	
h		h	
b	=	b'	=
G	° ′ ″		
$G+\alpha$	″		
sin. $(G+\alpha)$		cos. $(G+\alpha)$	
tan. δ			
g		g	
a	=	a'	=
f =			
		$d\delta$	=
$d\alpha$ in seconds of arc =			
$-\frac{1}{3}$		α =	° ′ ″
$d\alpha$ in seconds of time =	s.	δ =	

H	° ′ ″	i	
α	″	cos. δ	
$H+\alpha$	″	c'	=
sin. $(H+\alpha)$		cos. $(H+\alpha)$	
sec. δ		sin. δ	
h		h	
b	=	b'	=
G	° ′ ″		
$G+\alpha$	″		
sin. $(G+\alpha)$		cos. $(G+\alpha)$	
tan. δ			
g		g	
a	=	a'	=
f =			
		$d\delta$	=
$d\alpha$ in seconds of arc =			
$-\frac{1}{3}$		α =	° ′ ″
$d\alpha$ in seconds of time =	s.	δ =	

H	° ′ ″	i	
α	″	cos. δ	
$H+\alpha$	″	c'	=
sin. $(H+\alpha)$		cos. $(H+\alpha)$	
sec. δ		sin. δ	
h		h	
b	=	b'	=
G	° ′ ″		
$G+\alpha$	″		
sin. $(G+\alpha)$		cos. $(G+\alpha)$	
tan. δ			
g		g	
a	=	a'	=
f =			
		$d\delta$	=
$d\alpha$ in seconds of arc =			
$-\frac{1}{3}$		α =	° ′ ″
$d\alpha$ in seconds of time =	s.	δ =	

H	° ′ ″	i	
α	″	cos. δ	
$H+\alpha$	″	c'	=
sin. $(H+\alpha)$		cos. $(H+\alpha)$	
sec. δ		sin. δ	
h		h	
b	=	b'	=
G	° ′ ″		
$G+\alpha$	″		
sin. $(G+\alpha)$		cos. $(G+\alpha)$	
tan. δ			
g		g	
a	=	a'	=
f =			
		$d\delta$	=
$d\alpha$ in seconds of arc =			
$-\frac{1}{3}$		α =	° ′ ″
$d\alpha$ in seconds of time =	s.	δ =	

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OBSERVATORY OF HARVARD COLLEGE.

REDUCTION OF ZONES.

ZONE [Form, No. 2.]

Sidereal Time = h. m. Barometer = in. Att. Thermometer = ° Ext. Thermometer = °

" = " " = . " = . " = .

α	$d\alpha$	dt	$d\alpha + dt$	p	$k = p - d\alpha - dt$
h. m.	s.	s.	s.	"	"
"	.	.	.	.	.
"	.	.	.	.	.
"	.	.	.	.	.

α	$d\delta$	dr'	$d\delta + dr'$	q	$d = q - d\delta - dr'$
h. m.	"	"	"	"	"
"	.	.	.	.	.
"	.	.	.	.	.
"	.	.	.	.	.

Change of k for $+10'$ in Dec. = s. .

Change of d for $+10'$ in Dec. = " .

$\delta =$ ° ' "	$\delta =$ ° ' "	$\delta =$ ° ' "	$\delta =$ ° ' "
α	k	k	d	d
h. m.	s.	s.	"	"
"	.	.	.	.
"	.	.	.	.
"	.	.	.	.
"	.	.	.	.
"	.	.	.	.
"	.	.	.	.
"	.	.	.	.
"	.	.	.	.
"	.	.	.	.
"	.	.	.	.
"	.	.	.	.
"	.	.	.	.

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OBSERVATORY OF HARVARD COLLEGE.

REDUCTION OF ZONES.

ZONE 41

[Form, No. 1.]

H	° ′ ″	$=i$	″
α	″	$\cos.\ \delta$	
$H+\alpha$	″	c'	$=$ ″
$\sin.\ (H+\alpha)$		$\cos.\ (H+\alpha)$	
$\sec.\ \delta$		$\sin.\ \delta$	
$=h$	″	h	
b	$=$	b'	$=$
G	° ′ ″		
$G+\alpha$	″		
$\sin.\ (G+\alpha)$		$\cos.\ (G+\alpha)$	
$\tan.\ \delta$			
$=g$	″	g	
a	$=$	a'	$=$
$f=$			
		$d\,\delta$	$=$
$d\,\alpha$ in seconds of arc $=$		$\alpha=$	° ′ ″
$-\frac{1}{3}$			
$d\,\alpha$ in seconds of time $=$	s.	$\delta=$	

H	° ′ ″	$=i$	″
α	″	$\cos.\ \delta$	
$H+\alpha$	″	c'	$=$ ″
$\sin.\ (H+\alpha)$		$\cos.\ (H+\alpha)$	
$\sec.\ \delta$		$\sin.\ \delta$	
$=h$	″	h	
b	$=$	b'	$=$
G	° ′ ″		
$G+\alpha$	″		
$\sin.\ (G+\alpha)$		$\cos.\ (G+\alpha)$	
$\tan.\ \delta$			
$=g$	″	g	
a	$=$	a'	$=$
$f=$			
		$d\,\delta$	$=$
$d\,\alpha$ in seconds of arc $=$		$\alpha=$	° ′ ″
$-\frac{1}{3}$			
$d\,\alpha$ in seconds of time $=$	s.	$\delta=$	

H	° ′ ″	$=i$	″
α	″	$\cos.\ \delta$	
$H+\alpha$	″	c'	$=$ ″
$\sin.\ (H+\alpha)$		$\cos.\ (H+\alpha)$	
$\sec.\ \delta$		$\sin.\ \delta$	
$=h$	″	h	
b	$=$	b'	$=$
G	° ′ ″		
$G+\alpha$	″		
$\sin.\ (G+\alpha)$		$\cos.\ (G+\alpha)$	
$\tan.\ \delta$			
$=g$	″	g	
a	$=$	a'	$=$
$f=$			
		$d\,\delta$	$=$
$d\,\alpha$ in seconds of arc $=$		$\alpha=$	° ′ ″
$-\frac{1}{3}$			
$d\,\alpha$ in seconds of time $=$	s.	$\delta=$	

H	° ′ ″	$=i$	″
α	″	$\cos.\ \delta$	
$H+\alpha$	″	c'	$=$ ″
$\sin.\ (H+\alpha)$		$\cos.\ (H+\alpha)$	
$\sec.\ \delta$		$\sin.\ \delta$	
$=h$	″	h	
b	$=$	b'	$=$
G	° ′ ″		
$G+\alpha$	″		
$\sin.\ (G+\alpha)$		$\cos.\ (G+\alpha)$	
$\tan.\ \delta$			
$=g$	″	g	
a	$=$	a'	$=$
$f=$			
		$d\,\delta$	$=$
$d\,\alpha$ in seconds of arc $=$		$\alpha=$	° ′ ″
$-\frac{1}{3}$			
$d\,\alpha$ in seconds of time $=$	s.	$\delta=$	

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OBSERVATORY OF HARVARD COLLEGE.

REDUCTION OF ZONES.

ZONE [Form, No. 2.]

Sidereal Time = h. m. Barometer = in. Att. Thermometer = ° Ext. Thermometer = °

" = " " = . " = . " = .

α	$d\alpha$	dt	$d\alpha+dt$	p	$k=p-d\alpha-dt$
h. m.	s.	s.	s.	"	"
"	.	.	.	.	.
"	.	.	.	.	.
"	.	.	.	.	.

α	$d\delta$	dr'	$d\delta+dr'$	q	$d=q-d\delta-dr'$
h. m.	"	"	"	"	"
"	.	.	.	.	.
"	.	.	.	.	.
"	.	.	.	.	.

Change of k for $+10'$ in Dec. = s. . Change of d for $+10'$ in Dec. = " .

	$\delta=$ ° ' "	$\delta=$ ° ' "	$\delta=$ ° ' "	$\delta=$ ° ' "
α	k	k	d	d
h. m.	s.	s.	"	"
"	.	.	.	.
"	.	.	.	.
"	.	.	.	.
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"	.	.	.	.
"	.	.	.	.

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OBSERVATORY OF HARVARD COLLEGE.

REDUCTION OF ZONES.

ZONE 42

[Form, No. 1.]

H	° ′ ″	i	″
α	,,	cos. δ	
$H+\alpha$	,,	c'	″ =
sin. $(H+\alpha)$		cos. $(H+\alpha)$	
sec. δ		sin. δ	
h	″ =	h	
b	=	b'	=
G	° ′ ,,		
$G+\alpha$	,,		
sin. $(G+\alpha)$		cos. $(G+\alpha)$	
tan. δ			
g	″ =	g	
a	=	a'	=
f =			
		$d\delta$	=
$d\alpha$ in seconds of arc =			
$-\frac{1}{3}$		α =	° ′ ,,
$d\alpha$ in seconds of time =	s.	δ =	

H	° ′ ″	i	″
α	,,	cos. δ	
$H+\alpha$	,,	c'	″ =
sin. $(H+\alpha)$		cos. $(H+\alpha)$	
sec. δ		sin. δ	
h	″ =	h	
b	=	b'	=
G	° ′ ,,		
$G+\alpha$	,,		
sin. $(G+\alpha)$		cos. $(G+\alpha)$	
tan. δ			
g	″ =	g	
a	=	a'	=
f =			
		$d\delta$	=
$d\alpha$ in seconds of arc =			
$-\frac{1}{3}$		α =	° ′ ,,
$d\alpha$ in seconds of time =	s.	δ =	

H	° ′ ″	i	″
α	,,	cos. δ	
$H+\alpha$	,,	c'	″ =
sin. $(H+\alpha)$		cos. $(H+\alpha)$	
sec. δ		sin. δ	
h	″ =	h	
b	=	b'	=
G	° ′ ,,		
$G+\alpha$	,,		
sin. $(G+\alpha)$		cos. $(G+\alpha)$	
tan. δ			
g	″ =	g	
a	=	a'	=
f =			
		$d\delta$	=
$d\alpha$ in seconds of arc =			
$-\frac{1}{3}$		α =	° ′ ,,
$d\alpha$ in seconds of time =	s.	δ =	

H	° ′ ″	i	″
α	,,	cos. δ	
$H+\alpha$	,,	c'	″ =
sin. $(H+\alpha)$		cos. $(H+\alpha)$	
sec. δ		sin. δ	
h	″ =	h	
b	=	b'	=
G	° ′ ,,		
$G+\alpha$	,,		
sin. $(G+\alpha)$		cos. $(G+\alpha)$	
tan. δ			
g	″ =	g	
a	=	a'	=
f =			
		$d\delta$	=
$d\alpha$ in seconds of arc =			
$-\frac{1}{3}$		α =	° ′ ,,
$d\alpha$ in seconds of time =	s.	δ =	

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OBSERVATORY OF HARVARD COLLEGE.

REDUCTION OF ZONES.

ZONE [Form, No. 2.]

Sidereal Time = h. m. Barometer = in. Att. Thermometer = ° Ext. Thermometer = °

" = " " = . " = . " = .

α h. m.	$d\alpha$ s.	dt s.	$d\alpha+dt$ s.	p "	$k=p-d\alpha-dt$ "
"	.	.	.	.	.
"	.	.	.	.	.
"	.	.	.	.	.

α h. m.	$d\delta$ "	dr' "	$d\delta+dr'$ "	q "	$d=q-d\delta-dr'$ "
"	.	.	.	.	.
"	.	.	.	.	.
"	.	.	.	.	.

Change of k for $+10'$ in Dec. = s. .

Change of d for $+10'$ in Dec. = " .

δ = ° ' " δ = ° ' " δ = ° ' " δ = ° ' "

α h. m.	k s.	k s.	d "	d "
"	.	.	.	.
"	.	.	.	.
"	.	.	.	.
"	.	.	.	.
"	.	.	.	.
"	.	.	.	.
"	.	.	.	.
"	.	.	.	.
"	.	.	.	.
"	.	.	.	.
"	.	.	.	.
"	.	.	.	.
"	.	.	.	.

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OBSERVATORY OF HARVARD COLLEGE.

REDUCTION OF ZONES.

ZONE 43

[Form, No. 1.]

H	° ′ ″	i =	″
α	″	cos. δ	
$H+\alpha$	″	c'	= ″
sin. $(H+\alpha)$		cos. $(H+\alpha)$	
sec. δ	″	sin. δ	
h =	″	h	
b	=	b'	=
G	° ′ ″		
$G+\alpha$	″		
sin. $(G+\alpha)$		cos. $(G+\alpha)$	
tan. δ	″		
g =		g	
a	=	a'	=
f =			
		$d\delta$	=
$d\alpha$ in seconds of arc =			
$-\frac{1}{3}$		α =	° ′ ″
$d\alpha$ in seconds of time =	s.	δ =	

H	° ′ ″	i =	″
α	″	cos. δ	
$H+\alpha$	″	c'	= ″
sin. $(H+\alpha)$		cos. $(H+\alpha)$	
sec. δ	″	sin. δ	
h =	″	h	
b	=	b'	=
G	° ′ ″		
$G+\alpha$	″		
sin. $(G+\alpha)$		cos. $(G+\alpha)$	
tan. δ	″		
g =		g	
a	=	a'	=
f =			
		$d\delta$	=
$d\alpha$ in seconds of arc =			
$-\frac{1}{3}$		α =	° ′ ″
$d\alpha$ in seconds of time =	s.	δ =	

H	° ′ ″	i =	″
α	″	cos. δ	
$H+\alpha$	″	c'	= ″
sin. $(H+\alpha)$		cos. $(H+\alpha)$	
sec. δ	″	sin. δ	
h =	″	h	
b	=	b'	=
G	° ′ ″		
$G+\alpha$	″		
sin. $(G+\alpha)$		cos. $(G+\alpha)$	
tan. δ	″		
g =		g	
a	=	a'	=
f =			
		$d\delta$	=
$d\alpha$ in seconds of arc =			
$-\frac{1}{3}$		α =	° ′ ″
$d\alpha$ in seconds of time =	s.	δ =	

H	° ′ ″	i =	″
α	″	cos. δ	
$H+\alpha$	″	c'	= ″
sin. $(H+\alpha)$		cos. $(H+\alpha)$	
sec. δ	″	sin. δ	
h =	″	h	
b	=	b'	=
G	° ′ ″		
$G+\alpha$	″		
sin. $(G+\alpha)$		cos. $(G+\alpha)$	
tan. δ	″		
g =		g	
a	=	a'	=
f =			
		$d\delta$	=
$d\alpha$ in seconds of arc =			
$-\frac{1}{3}$		α =	° ′ ″
$d\alpha$ in seconds of time =	s.	δ =	

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OBSERVATORY OF HARVARD COLLEGE.

REDUCTION OF ZONES.

ZONE [Form, No. 2.]

Sidereal Time = h. m. Barometer = in. Att. Thermometer = ° Ext. Thermometer = °

" = " " = . " = . " = .

α h. m.	$d\alpha$ s.	dt s.	$d\alpha+dt$ s.	p "	$k=p-d\alpha-dt$ "
"	.	.	.	.	.
"	.	.	.	.	.
"	.	.	.	.	.

α h. m.	$d\delta$ "	dr' "	$d\delta+dr'$ "	q "	$d=q-d\delta-dr'$ "
"	.	.	.	.	.
"	.	.	.	.	.
"	.	.	.	.	.

Change of k for $+10'$ in Dec. = s. .

Change of d for $+10'$ in Dec. = " .

	δ = ° ' "	δ = ° ' "	δ = ° ' "	δ = ° ' "
α h. m.	k s.	k s.	d "	d "
"	.	.	.	.
"	.	.	.	.
"	.	.	.	.
"	.	.	.	.
"	.	.	.	.
"	.	.	.	.
"	.	.	.	.
"	.	.	.	.
"	.	.	.	.
"	.	.	.	.
"	.	.	.	.
"	.	.	.	.
"	.	.	.	.

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OBSERVATORY OF HARVARD COLLEGE.

REDUCTION OF ZONES.

ZONE 44

[Form, No. 1.]

H	° ′ ″	i	″
α	″	cos. δ	
$H+\alpha$	″	c'	″ =
sin. $(H+\alpha)$		cos. $(H+\alpha)$	
sec. δ	″	sin. δ	
h	″ =	h	
b	″ =	b'	=
G	° ′ ″		
$G+\alpha$	″		
sin. $(G+\alpha)$		cos. $(G+\alpha)$	
tan. δ	″		
g	″ =	g	
a	=	a'	=
f =			
		$d\delta$	=
$d\alpha$ in seconds of arc =		α =	° ′ ″
$-\frac{1}{3}$			
$d\alpha$ in seconds of time =	s.	δ =	

H	° ′ ″	i	″
α	″	cos. δ	
$H+\alpha$	″	c'	″ =
sin. $(H+\alpha)$		cos. $(H+\alpha)$	
sec. δ	″	sin. δ	
h	″ =	h	
b	″ =	b'	=
G	° ′ ″		
$G+\alpha$	″		
sin. $(G+\alpha)$		cos. $(G+\alpha)$	
tan. δ	″		
g	″ =	g	
a	=	a'	=
f =			
		$d\delta$	=
$d\alpha$ in seconds of arc =		α =	° ′ ″
$-\frac{1}{3}$			
$d\alpha$ in seconds of time =	s.	δ =	

H	° ′ ″	i	″
α	″	cos. δ	
$H+\alpha$	″	c'	″ =
sin. $(H+\alpha)$		cos. $(H+\alpha)$	
sec. δ	″	sin. δ	
h	″ =	h	
b	″ =	b'	=
G	° ′ ″		
$G+\alpha$	″		
sin. $(G+\alpha)$		cos. $(G+\alpha)$	
tan. δ	″		
g	″ =	g	
a	=	a'	=
f =			
		$d\delta$	=
$d\alpha$ in seconds of arc =		α =	° ′ ″
$-\frac{1}{3}$			
$d\alpha$ in seconds of time =	s.	δ =	

H	° ′ ″	i	″
α	″	cos. δ	
$H+\alpha$	″	c'	″ =
sin. $(H+\alpha)$		cos. $(H+\alpha)$	
sec. δ	″	sin. δ	
h	″ =	h	
b	″ =	b'	=
G	° ′ ″		
$G+\alpha$	″		
sin. $(G+\alpha)$		cos. $(G+\alpha)$	
tan. δ	″		
g	″ =	g	
a	=	a'	=
f =			
		$d\delta$	=
$d\alpha$ in seconds of arc =		α =	° ′ ″
$-\frac{1}{3}$			
$d\alpha$ in seconds of time =	s.	δ =	

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OBSERVATORY OF HARVARD COLLEGE.

REDUCTION OF ZONES.

ZONE [Form, No. 2.]

Sidereal Time = h. m. Barometer = in. Att. Thermometer = ° Ext. Thermometer = °

" = " " = . " = . " = .

α	$d\alpha$	dt	$d\alpha + dt$	p	$k = p - d\alpha - dt$
h. m.	s.	s.	s.	"	"
"	.	.	.	.	.
"	.	.	.	.	.
"	.	.	.	.	.

α	$d\delta$	dr'	$d\delta + dr'$	q	$d = q - d\delta - dr'$
h. m.	"	"	"	"	"
"	.	.	.	.	.
"	.	.	.	.	.
"	.	.	.	.	.

Change of k for $+10'$ in Dec. = s. .

Change of d for $+10'$ in Dec. = " .

	$\delta =$ ° ' "	$\delta =$ ° ' "	$\delta =$ ° ' "	$\delta =$ ° ' "
α	k	k	d	d
h. m.	s.	s.	"	"
"	.	.	.	.
"	.	.	.	.
"	.	.	.	.
"	.	.	.	.
"	.	.	.	.
"	.	.	.	.
"	.	.	.	.
"	.	.	.	.
"	.	.	.	.
"	.	.	.	.
"	.	.	.	.
"	.	.	.	.
"	.	.	.	.

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OBSERVATORY OF HARVARD COLLEGE.

REDUCTION OF ZONES.

ZONE 45

[Form, No. 1.]

H	° ′ ″	i	″
α	″	cos. δ	″
$H+\alpha$	″	c'	″
sin. $(H+\alpha)$		cos. $(H+\alpha)$	
sec. δ		sin. δ	
h	″	h	″
b	″	b'	″
G	° ′ ″		
$G+\alpha$	″		
sin. $(G+\alpha)$		cos. $(G+\alpha)$	
tan. δ			
g		g	
a		a'	
f			
$d\alpha$ in seconds of arc		$d\delta$	
$-\frac{1}{3}$		α	° ′ ″
$d\alpha$ in seconds of time	s.	δ	

H	° ′ ″	i	″
α	″	cos. δ	″
$H+\alpha$	″	c'	″
sin. $(H+\alpha)$		cos. $(H+\alpha)$	
sec. δ		sin. δ	
h	″	h	″
b	″	b'	″
G	° ′ ″		
$G+\alpha$	″		
sin. $(G+\alpha)$		cos. $(G+\alpha)$	
tan. δ			
g		g	
a		a'	
f			
$d\alpha$ in seconds of arc		$d\delta$	
$-\frac{1}{3}$		α	° ′ ″
$d\alpha$ in seconds of time	s.	δ	

H	° ′ ″	i	″
α	″	cos. δ	″
$H+\alpha$	″	c'	″
sin. $(H+\alpha)$		cos. $(H+\alpha)$	
sec. δ		sin. δ	
h	″	h	″
b	″	b'	″
G	° ′ ″		
$G+\alpha$	″		
sin. $(G+\alpha)$		cos. $(G+\alpha)$	
tan. δ			
g		g	
a		a'	
f			
$d\alpha$ in seconds of arc		$d\delta$	
$-\frac{1}{3}$		α	° ′ ″
$d\alpha$ in seconds of time	s.	δ	

H	° ′ ″	i	″
α	″	cos. δ	″
$H+\alpha$	″	c'	″
sin. $(H+\alpha)$		cos. $(H+\alpha)$	
sec. δ		sin. δ	
h	″	h	″
b	″	b'	″
G	° ′ ″		
$G+\alpha$	″		
sin. $(G+\alpha)$		cos. $(G+\alpha)$	
tan δ			
g		g	
a		a'	
f			
$d\alpha$ in seconds of arc		$d\delta$	
$-\frac{1}{3}$		α	° ′ ″
$d\alpha$ in seconds of time	s.	δ	

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OBSERVATORY OF HARVARD COLLEGE.

REDUCTION OF ZONES.

ZONE

[Form, No. 2.]

Sidereal Time = h. m.
" = "

Barometer = in.
" = .

Att. Thermometer = °
" = .

Ext. Thermometer = °
" = .

α	$d\alpha$	dt	$d\alpha+dt$	p	$k=p-d\alpha-dt$
h. m.	s.	s.	s.	"	"
"	.	.	.	.	.
"	.	.	.	.	.
"	.	.	.	.	.

α	$d\delta$	dr'	$d\delta+dr'$	q	$d=q-d\delta-dr'$
h. m.	"	"	"	"	"
"	.	.	.	.	.
"	.	.	.	.	.
"	.	.	.	.	.

Change of k for $+10'$ in Dec. = s.

Change of d for $+10'$ in Dec. = "

	δ = ° ' "	δ = ° ' "	δ = ° ' "	δ = ° ' "
α	k	k	d	d
h. m.	s.	s.	"	"
"	.	.	.	.
"	.	.	.	.
"	.	.	.	.
"	.	.	.	.
"	.	.	.	.
"	.	.	.	.
"	.	.	.	.
"	.	.	.	.
"	.	.	.	.
"	.	.	.	.
"	.	.	.	.
"	.	.	.	.
"	.	.	.	.

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OBSERVATORY OF HARVARD COLLEGE.

REDUCTION OF ZONES.

ZONE 46

[Form, No. 1.]

H	° ′ ″	i	″
α	″	cos. δ	
$H+\alpha$	″	c'	″ =
sin. $(H+\alpha)$		cos. $(H+\alpha)$	
sec. δ		sin. δ	
h	″	h	
b	″ =	b'	=
G	° ′ ″		
$G+\alpha$	″		
sin. $(G+\alpha)$		cos. $(G+\alpha)$	
tan. δ			
g	″	g	
a	=	a'	=
f =			
$d\alpha$ in seconds of arc =		$d\delta$	=
$-\frac{1}{3}$		α =	° ′ ″
$d\alpha$ in seconds of time =	s.	δ =	

H	° ′ ″	i	″
α	″	cos. δ	
$H+\alpha$	″	c'	″ =
sin. $(H+\alpha)$		cos. $(H+\alpha)$	
sec. δ		sin. δ	
h	″	h	
b	″ =	b'	=
G	° ′ ″		
$G+\alpha$	″		
sin. $(G+\alpha)$		cos. $(G+\alpha)$	
tan. δ			
g	″	g	
a	=	a'	=
f =			
$d\alpha$ in seconds of arc =		$d\delta$	=
$-\frac{1}{3}$		α =	° ′ ″
$d\alpha$ in seconds of time =	s.	δ =	

H	° ′ ″	i	″
α	″	cos. δ	
$H+\alpha$	″	c'	″ =
sin. $(H+\alpha)$		cos. $(H+\alpha)$	
sec. δ		sin. δ	
h	″	h	
b	″ =	b'	=
G	° ′ ″		
$G+\alpha$	″		
sin. $(G+\alpha)$		cos. $(G+\alpha)$	
tan. δ			
g	″	g	
a	=	a'	=
f =			
$d\alpha$ in seconds of arc =		$d\delta$	=
$-\frac{1}{3}$		α =	° ′ ″
$d\alpha$ in seconds of time =	s.	δ =	

H	° ′ ″	i	″
α	″	cos. δ	
$H+\alpha$	″	c'	″ =
sin. $(H+\alpha)$		cos. $(H+\alpha)$	
sec. δ		sin. δ	
h	″	h	
b	″ =	b'	=
G	° ′ ″		
$G+\alpha$	″		
sin. $(G+\alpha)$		cos. $(G+\alpha)$	
tan δ			
g	″	g	
a	=	a'	=
f =			
$d\alpha$ in seconds of arc =		$d\delta$	=
$-\frac{1}{3}$		α =	° ′ ″
$d\alpha$ in seconds of time =	s.	δ =	

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OBSERVATORY OF HARVARD COLLEGE.

REDUCTION OF ZONES.

ZONE

[Form, No. 2.]

Sidereal Time = h. m. Barometer = in. Att. Thermometer = ° Ext. Thermometer = °

" = " " = . " = . " = .

α h. m.	$d\alpha$ s.	dt s.	$d\alpha + dt$ s.	p "	$k = p - d\alpha - dt$ "
"	.	.	.	.	.
"	.	.	.	.	.
"	.	.	.	.	.

α h. m.	$d\delta$ "	dr' "	$d\delta + dr'$ "	q "	$d = q - d\delta - dr'$ "
"	.	.	.	.	.
"	.	.	.	.	.
"	.	.	.	.	.

Change of k for $+10'$ in Dec. = s. .

Change of d for $+10'$ in Dec. = " .

	δ = ° ' "	δ = ° ' "	δ = ° ' "	δ = ° ' "
α h. m.	k s.	k s.	d "	d "
"	.	.	.	.
"	.	.	.	.
"	.	.	.	.
"	.	.	.	.
"	.	.	.	.
"	.	.	.	.
"	.	.	.	.
"	.	.	.	.
"	.	.	.	.
"	.	.	.	.
"	.	.	.	.
"	.	.	.	.
"	.	.	.	.

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OBSERVATORY OF HARVARD COLLEGE.

REDUCTION OF ZONES.

ZONE 47

[Form, No. 1.]

H	° ′ ″	$=i$	.
α	,,	cos. δ	.
$H+\alpha$	,,	c'	= ″ .
sin. $(H+\alpha)$	.	cos. $(H+\alpha)$	.
sec. δ	.	sin. δ	.
$=h$	″ .	h	.
b	. = ″ .	b'	. = .
G	° ′ ,,		
$G+\alpha$	,,		
sin. $(G+\alpha)$	.	cos. $(G+\alpha)$	.
tan. δ	.		
$=g$	″ .	g	.
a	. = .	a'	. = .
$f=$	.		
		$d\delta$	= .
$d\alpha$ in seconds of arc =	.		
$-\frac{1}{3}$	.	$\alpha=$	° ′ ,,
$d\alpha$ in seconds of time =	s. .	$\delta=$	

H	° ′ ″	$=i$	.
α	,,	cos. δ	.
$H+\alpha$	,,	c'	= ″ .
sin. $(H+\alpha)$	.	cos. $(H+\alpha)$	.
sec. δ	.	sin. δ	.
$=h$	″ .	h	.
b	. = ″ .	b'	. = .
G	° ′ ,,		
$G+\alpha$	,,		
sin. $(G+\alpha)$	.	cos. $(G+\alpha)$	.
tan. δ	.		
$=g$	″ .	g	.
a	. = .	a'	. = .
$f=$	.		
		$d\delta$	= .
$d\alpha$ in seconds of arc =	.		
$-\frac{1}{3}$	.	$\alpha=$	° ′ ,,
$d\alpha$ in seconds of time =	s. .	$\delta=$	

H	° ′ ″	$=i$	.
α	,,	cos. δ	.
$H+\alpha$	,,	c'	= ″ .
sin. $(H+\alpha)$	.	cos. $(H+\alpha)$	.
sec. δ	.	sin. δ	.
$=h$	″ .	h	.
b	. = ″ .	b'	. = .
G	° ′ ,,		
$G+\alpha$	,,		
sin. $(G+\alpha)$	.	cos. $(G+\alpha)$	.
tan. δ	.		
$=g$	″ .	g	.
a	. = .	a'	. = .
$f=$	.		
		$d\delta$	= .
$d\alpha$ in seconds of arc =	.		
$-\frac{1}{3}$	.	$\alpha=$	° ′ ,,
$d\alpha$ in seconds of time =	s. .	$\delta=$	

H	° ′ ″	$=i$	.
α	,,	cos. δ	.
$H+\alpha$	,,	c'	= ″ .
sin. $(H+\alpha)$	.	cos. $(H+\alpha)$	.
sec. δ	.	sin. δ	.
$=h$	″ .	h	.
b	. = ″ .	b'	. = .
G	° ′ ,,		
$G+\alpha$	,,		
sin. $(G+\alpha)$	.	cos. $(G+\alpha)$	.
tan. δ	.		
$=g$	″ .	g	.
a	. = .	a'	. = .
$f=$	.		
		$d\delta$	= .
$d\alpha$ in seconds of arc =	.		
$-\frac{1}{3}$	.	$\alpha=$	° ′ ,,
$d\alpha$ in seconds of time =	s. .	$\delta=$	

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OBSERVATORY OF HARVARD COLLEGE.

REDUCTION OF ZONES.

ZONE [Form, No. 2.]

Sidereal Time = h. m. Barometer = in. Att. Thermometer = ° Ext. Thermometer = °

" = " " = . " = . " = .

α	$d\alpha$	dt	$d\alpha + dt$	p	$k = p - d\alpha - dt$
h. m.	s.	s.	s.	"	"
"	.	.	.	.	.
"	.	.	.	.	.
"	.	.	.	.	.

α	$d\delta$	dr'	$d\delta + dr'$	q	$d = q - d\delta - dr'$
h. m.	"	"	"	"	"
"	.	.	.	.	.
"	.	.	.	.	.
"	.	.	.	.	.

Change of k for $+10^{l}$ in Dec. = s. Change of d for $+10^{l}$ in Dec. = "

$\delta =$ ° ' $\delta =$ ° ' $\delta =$ ° ' $\delta =$ ° '

" " " "

α	k	k	d	d
h. m.	s.	s.	"	"
"	.	.	.	.
"	.	.	.	.
"	.	.	.	.
"	.	.	.	.
"	.	.	.	.
"	.	.	.	.
"	.	.	.	.
"	.	.	.	.
"	.	.	.	.
"	.	.	.	.
"	.	.	.	.
"	.	.	.	.
"	.	.	.	.

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OBSERVATORY OF HARVARD COLLEGE.

REDUCTION OF ZONES.

ZONE 48

[Form, No. 1.]

H	° ′ ″	$\cdot = i$	″
α	″	cos. δ	
$H+\alpha$	″	c'	″ =
sin. $(H+\alpha)$		cos. $(H+\alpha)$	
sec. δ		sin. δ	
$\cdot = h$	″	h	
b	″ =	b'	=
G	° ′ ″		
$G+\alpha$	″		
sin. $(G+\alpha)$		cos. $(G+\alpha)$	
tan. δ			
$\cdot = g$		g	
a	=	a'	=
$f =$			
		$d\delta$	=
$d\alpha$ in seconds of arc =			° ′
$-\frac{1}{3}$		$\alpha =$	″
$d\alpha$ in seconds of time =	s.	$\delta =$	

H	° ′ ″	$\cdot = i$	″
α	″	cos. δ	
$H+\alpha$	″	c'	″ =
sin. $(H+\alpha)$		cos. $(H+\alpha)$	
sec. δ		sin. δ	
$\cdot = h$	″	h	
b	″ =	b'	=
G	° ′ ″		
$G+\alpha$	″		
sin. $(G+\alpha)$		cos. $(G+\alpha)$	
tan. δ			
$\cdot = g$		g	
a	=	a'	=
$f =$			
		$d\delta$	=
$d\alpha$ in seconds of arc =			° ′
$-\frac{1}{3}$		$\alpha =$	″
$d\alpha$ in seconds of time =	s.	$\delta =$	

H	° ′ ″	$\cdot = i$	″
α	″	cos. δ	
$H+\alpha$	″	c'	″ =
sin. $(H+\alpha)$		cos. $(H+\alpha)$	
sec. δ		sin. δ	
$\cdot = h$	″	h	
b	″ =	b'	=
G	° ′ ″		
$G+\alpha$	″		
sin. $(G+\alpha)$		cos. $(G+\alpha)$	
tan. δ			
$\cdot = g$		g	
a	=	a'	=
$f =$			
		$d\delta$	=
$d\alpha$ in seconds of arc =			° ′
$-\frac{1}{3}$		$\alpha =$	″
$d\alpha$ in seconds of time =	s.	$\delta =$	

H	° ′ ″	$\cdot = i$	″
α	″	cos. δ	
$H+\alpha$	″	c'	″ =
sin. $(H+\alpha)$		cos. $(H+\alpha)$	
sec. δ		sin. δ	
$\cdot = h$	″	h	
b	″ =	b'	=
G	° ′ ″		
$G+\alpha$	″		
sin. $(G+\alpha)$		cos. $(G+\alpha)$	
tan. δ			
$\cdot = g$		g	
a	=	a'	=
$f =$			
		$d\delta$	=
$d\alpha$ in seconds of arc =			° ′
$-\frac{1}{3}$		$\alpha =$	″
$d\alpha$ in seconds of time =	s.	$\delta =$	

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OBSERVATORY OF HARVARD COLLEGE.

REDUCTION OF ZONES.

ZONE

[Form, No. 2.]

Sidereal Time = h. m. Barometer = in. Att. Thermometer = ° Ext. Thermometer = °

" = " " = . " = . " = .

α	$d\alpha$	dt	$d\alpha+dt$	p	$k=p-d\alpha-dt$
h. m.	s.	s.	s.	"	"
"	.	.	.	.	.
"	.	.	.	.	.
"	.	.	.	.	.

α	$d\delta$	dr'	$d\delta+dr'$	q	$d=q-d\delta-dr'$
h. m.	"	"	"	"	"
"	.	.	.	.	.
"	.	.	.	.	.
"	.	.	.	.	.

Change of k for $+10'$ in Dec. = s. .

Change of d for $+10'$ in Dec. = " .

δ = ° ' " δ = ° ' " δ = ° ' " δ = ° ' "

α	k	k	d	d
h. m.	s.	s.	"	"
"	.	.	.	.
"	.	.	.	.
"	.	.	.	.
"	.	.	.	.
"	.	.	.	.
"	.	.	.	.
"	.	.	.	.
"	.	.	.	.
"	.	.	.	.
"	.	.	.	.
"	.	.	.	.
"	.	.	.	.
"	.	.	.	.

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OBSERVATORY OF HARVARD COLLEGE.

REDUCTION OF ZONES.

ZONE 49 April 27th 1853 — R 11h 52m 52s — Dec 0° 00′ 0″ — [Form, No. 1.]

H	230° 04′	$-6.44 = i$		H	230° 04′	$-6.44 = i$	
α	180° 00′	$\cos\delta$	0.00000	α	210° 00′	$\cos\delta$	0.00000
$H+\alpha$	50° 04′	c'	$= -6.44$	$H+\alpha$	80° 04′	c'	$= -6.44$
$\sin.(H+\alpha)$	9.88468	$\cos.(H+\alpha)$	9.80746	$\sin.(H+\alpha)$	9.99344	$\cos.(H+\alpha)$	9.23679
$\sec.\delta$	0.00000	$\sin.\delta$	$-\infty$	$\sec.\delta$	0.00000	$\sin.\delta$	$-\infty$
$+19.37 = h$	1.28713	h		$+19.37 = h$	1.28713	h	
b	$1.17181 = +14.85$	b'	$= 0.00$	b	$1.28057 = +19.08$	b'	$= 0.00$
G	239° 51′			G	239° 51′		
$G+\alpha$	59° 51′			$G+\alpha$	89° 51′		
$\sin.(G+\alpha)$	9.93687	$\cos.(G+\alpha)$	9.70093	$\sin.(G+\alpha)$	0.00000	$\cos.(G+\alpha)$	7.41797
$\tan.\delta$	$-\infty$			$\tan.\delta$	$-\infty$		
$+1.77 = g$		g	0.24797	$+1.77 = g$		g	0.24797
a	$= 0.00$	a'	$9.94890 = +0.89$	a	$= 0.00$	a'	$7.66594 = +0.01$
	$f = -2.04$				$f = -2.04$		
		$d\delta$	$= -5.55$			$d\delta$	$= -6.43$
$d\alpha$ in seconds of arc	$= +12.81$			$d\alpha$ in seconds of arc	$= +17.04$		
	$-\frac{1}{3}$ 4.27	α	$= 12^h\ 00'$		$-\frac{1}{3}$ 5.68	α	$= 14^h\ 00^m$
$d\alpha$ in seconds of time	$= +0.854$ s.	δ	$= 0° 00′$	$d\alpha$ in seconds of time	$= +1.136$ s.	δ	$= 0° 00′$

H	230° 04′	$-6.44 = i$		H	230° 04′	$-6.44 = i$	
α	195° 00′	$\cos\delta$		α	195° 00′	$\cos\delta$	
$H+\alpha$	65° 04′	c'	$= -6.44$	$H+\alpha$	65° 04′	c'	$= -6.44$
$\sin.(H+\alpha)$	9.95751	$\cos.(H+\alpha)$	9.62486	$\sin.(H+\alpha)$	9.95751	$\cos.(H+\alpha)$	9.62486
$\sec.\delta$	0.00000	$\sin.\delta$	$-\infty$	$\sec.\delta$	0.00000	$\sin.\delta$	7.46373
$+19.37 = h$	1.28713	h		$+19.37 = h$	1.28713	h	1.28713
b	$1.24464 = +17.56$	b'	$= 0.00$	b	$1.24464 = +17.56$	b'	$8.37572 = +0.02$
G	239° 51′			G	239° 51′		
$G+\alpha$	74° 51′			$G+\alpha$	74° 51′		
$\sin.(G+\alpha)$	9.98464	$\cos.(G+\alpha)$	9.41722	$\sin.(G+\alpha)$	9.98464	$\cos.(G+\alpha)$	9.41722
$\tan.\delta$	$-\infty$			$\tan.\delta$	7.46373		
$+1.77 = g$		g	0.24797	$+1.77 = g$	0.24797	g	0.24797
a	$= 0.00$	a'	$9.66519 = +0.46$	a	$7.69634 = +0.01$	a'	$9.66519 = +0.46$
	$f = -2.04$				$f = -2.04$		
		$d\delta$	$= -5.98$			$d\delta$	$= -5.96$
$d\alpha$ in seconds of arc	$= +15.52$			$d\alpha$ in seconds of arc	$= +15.53$		
	$-\frac{1}{3}$ 5.17	α	$= 13^h\ 00^m$		$-\frac{1}{3}$ 5.18	α	$= 13^h\ 00'$
$d\alpha$ in seconds of time	$= +1.035$ s.	δ	$= 0° 00′$	$d\alpha$ in seconds of time	$= +1.035$ s.	δ	$= +0° 10′$

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OBSERVATORY OF HARVARD COLLEGE.

REDUCTION OF ZONES.

ZONE 49 EC Gain +1.58 daily [Form, No. 2.]

k = 0h.20m W

Sidereal Time = 12h 12m Barometer = 30.150 in. Att. Thermometer = 63.° Ext. Thermometer = 48.°1 +0.06
" = 14h 14m " = 30.182 " = 64. " = 44.2 +0.43
+0.032 −3.9 0.49

α h. m.	dα s.	dt s.	dα+dt s.	p s.	k = p − dα − dt s.
12 h 00	+0.854	+0.000	+0.854	+1.247	+0.393
13 h 00	1.035	.070	+1.105	+1.247	+0.142
14 h 00	1.136	+0.140	+1.276	+1.247	−0.029

φ = 46°

α h. m.	dδ "	dr' "	dδ+dr' "	q "	d = q − dδ − dr' "
12 h 00	−5.55	+0.00	−5.55	−2.20	+3.35
13 h 00	−5.58	+0.25	−5.73	−2.20	+3.55
14 h 00	−6.43	+0.49	−5.94	−2.20	+3.74

dδ = +1.30
dr = 0.30
dδ − dr = +1.00
dδ − dδ'1 = − 02
−1.02

Change of k for +10' in Dec. = ∓0.s001

Change of d for +10' in Dec. = −1.02

α h. m.	k (δ = 0° 00') s.	k (δ = 0° 10') s.	d (δ = 0° 00') "	d (δ = 0° 10') "
11 h 50	+0.44	+0.44	+3.34	+2.34
12 h 00	.39	.39	3.4	2.34
10	.34	.	3.5	2.4
20	.30	.	3.5	2.4
30	.26	.	3.5	2.5
40	.22	.	3.5	2.5
12 h 50	.18	.	3.5	2.5
13 h 00	.14	.	3.5	2.5
10	.11	.	3.6	2.5
20	.07	.	3.6	2.5
30	.04	.	3.6	2.6
40	+.01	.	3.6	2.6
13 h 50	−.01		3.6	2.6
14 h 00	−0.03		+3.7	+2.6

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Test of $d\alpha$

B Leonis April 27 Ap. M 11h 41m 34.28 Dec + 15° 23′ 35.4
Arcturus 14h 08m 58.64 19° 56′ 53.5
11h 41m 33.45 15° 23′ 37.0
Mean M 14h 08m 57.40 19° 56′ 59.3
$d\alpha$ +0.83 − 1.6
+1.24 − 5.8
2.45) 41 (0.17 2.45) − 4.2 (1.7
245
1650

For change of M $d\alpha$ increases hourly +s.17 $d\delta$ decreases hourly − 1.7
By comp +0.14 + − 0.4 −

Stars from Mr Runkle's Catalogue

M 11h 52m to M 13h 54m
Dec 0° 00′ 0° 10′

---

a Vi 907 h m s 11 52 52.90 δ = 0° 07′ 31.1 W1 13 12 02 07.36 0 02 44.8
52.60 δ_{49} 0 07 31.0 07.15 2 43.0
t_{49} 52.20 δ_{50} 7 29.0 06.90 2 42.0
t_{50} +.30 +0.1 +.21 +1.8
$\alpha - t_{49}$ = +.70 +2.1 +.46 +2.8
$\alpha - t_{50}$ = +.81 −4.7 +.86 −5.4
$d\alpha + dt$ +.82 −4.9 +.86 −5.4
$d\alpha + dt$ +1.11 −4.6 +1.07 −3.6
p_{49} = +1.52 −2.8 +1.32 −2.6
p_{50} =

W1 10 12 01 54.52 0 03 38.5 wt W167 12 11 07.81 1 0 01 44.7 1
54.10 3 37.0 g 8.33 2 49.2 1
53.85 3 34.0 S 839 8.26 3 50.3 2
+.42 +1.5 Arg 1000 8.24 4 48.5 3
+.67 +4.5 BAC 4137 8.22 3 48.5 2
+.86 −5.2 12 11 08.22 13 0 01 48.8 13
+.86 −5.3 7.80 1 44.0
+1.28 −3.7 7.50 1 43.0
+1.53 −0.8 +.42 +4.8
+.72 +5.8
+.90 −5.5
+.90 −5.5
+1.32 −0.7
+1.62 +0.3

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1853.0

W 191	12..12..23.38		0..08..59.2			
g	22.77		9..03.5			
Sant. 840	23.20		9..02.4			
Airy 1002	23.12		9..00.3			
BAC 4145	23.09	wt	9..01.5	wt		
	12..12..23.09	13	0..9 01.8	13		
	22.85		8..58.0			
	22.60		8..57.0			
	+.24		+3.8			
	+.49		+4.8			
	+.90		-4.7			
	+.90		-5.0			
	+1.14		-0.9			
	+1.39		-0.2			

W 949	12..55..16.78		-0°00'12".0			
San 890	16.94	wt	9.4	wt		
	12..55..16.90	4	-0°00'10".0	4		
	16.70		-0..00..14.0			
	16.25		-0..00..17.0			
	+.20		+4.0			
p_{49} = +1.27	+.65	q_{49} = -1.7	+7.0			
p_{50} = +1.73	+1.07	q_{50} = +1.3	-5.7			
	+1.08		-5.7			

W 1010	12..58..39.37	0..08..55.9	W = 1
	39.10	8..57.0	
	38.70	8..56.0	
	.27	-1.9	
	.67	-0.1	
	+1.10	-4.8	
	+1.10	-5.1	
	+1.37	-6.7	
	+1.77	-5.6	

736 W	12..43..12.08	0..03..05.0	
	11.75	2..52.0	
	11.25	2..51.0	
	+.25		
	+.75		
	+1.02		
	+1.02		
	+1.27		
	+1.77		

W 20	13..07..32.87	0..10..01.0	

W781	12..45..56.04	0..02..06.0	
	55.95	2..05.0	
	55.50	2..02.0	
	+.09	+1.0	
	+.54	+4.0	
	+1.05	-5.5	
	+1.06	-5.6	
p_{49} =	+1.14	-4.5	
p_{50} =	+1.60	-1.6	

W 159	13..09..59.27	0..05..56.6		
Sant.	58.56	wt	6..01.1	
	13..09..58.70	4	0..6..00.0	wt = 4
t	58.65	5	0..5..58.0	
	58.00		0..5..56.0	
	+.05		+2.0	
	+.70		+4.0	
	+1.14		-5.2	
	+1.13		-5.4	
	+1.19		-3.2	
	+1.83		-1.4	

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1853.0

W 258 13h 16m 12.04 0h 02m 59.7

t_{49}	11.65	s_{49}	2m 59.0
t_{50}	11.10	s_{50}	2m 58.0
	+ .39		+ 0.7
	+ .94		+ 1.7
	+ 1.15		− 5.6
	+ 1.15		− 5.6
p_{49}	+ 1.54		
p_{50}	+ 2.09	q_{49}	− 4.9
	12.82 Mosp. mo	q_{50}	− 3.9

+W 457 13h 27m 12.24 −.39 0h 09m 30.2

q	27m 12.64		26.7
Saint 922	12.47		22.6
Airy	12.43		26.1
B.A.C	12.49	wt	26.9 wt
	13h 27m 12.52	13	0m 09m 25.1 13
	12.30		9m 24.0
	11.90		9m 20.0
	+ 22		+ 5.1
	+ 62		+ 5.1
	+ 1.18		− 4.9
	+ 1.19		− 5.2
	+ 1.40		− 3.8
	+ 1.81		− 0.1

W 514 13h 30m 15.63 0h 07m 27.7

	15.25		7m 28.0
	14.80		7m 27.0
	+ 38		− 0.3
	+ 83		+ 0.7
	+ 1.19		− 5.1
	+ 1.20		− 5.4
	+ 1.57		− 5.4
	+ 2.03		− 4.7

Zone 49

				Dec wt	
$p = +1.^s11$	wt = 1	$q = -4.''6$	1	$11^h.52$	
+1.28	1	−3.7	1	12.02	
1.07	1	−3.6	1	12.02	
1.32	13	−0.7	9	12.11	
1.14	13	−0.9	9	12.12	
1.27	1			12.43	
1.14	1	−4.5	1	12.46	
1.27	4	−1.7	3	12.55	
1.37	1	−6.7	1	12.59	
1.19	4	−3.2	3	13.09	
1.54	1	−4.9	1	13.16	
1.40	13	−3.8	9	13.27	
1.57	1	−5.4	1	13.30	

1st half $12^h.09^m$ $p_{49} = +1.^s222$ wt = 29 * See next page

2nd " 13.14 +1.343 26

$12^h.41^m$ Mean $p_{49} = +1.282$ 55

1st half 12.09 $q_{49} = -1.''25$ 21

2nd " 13.15 $q_{49} = -3.70$ 19

Mean $12^h.42^m$ $q_{49} = -2.49$ wt 40

For p

$(x-x_0)$	$(x-x_0)^2$	$(x-x_0)^2 w$
17	29	29
0	0	0
21	44	44
4	2	26
14	20	260
1	0	0
14	20	20
1	0	0
9	8	8
9	8	32
26	68	68
12	14	183
29	84	84

$n-1 = 12 \overline{)754}$

63

For q

$x-x_0$		$(x-x_0)^2 w$
2.1	4	4
1.2	1	1
1.1	1	1
1.8	3.2	29
1.6	2.6	23
2.0	4	4
0.8	1	3
4.2	18	18
0.7	0	0
2.4	6	6
1.3	1.7	15
2.9	8	8

$n-1 = 11 \overline{)113}$

10.3

By Zone 49 Probable error of p from a star of wt = 1 is $\varepsilon = 0.674 \sqrt{63} = 25 \times .674 = 0.^s168$

$\sqrt{10.3} = 3.2$ Pr. er. for q $= \pm 2.''25$

0.67

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Zone 50

			wt.
$p = +1.52^s$	IN = 1	$q = -2.8''$	1
1.53	1	−0.8	1
1.32	1	−2.6	1
1.62	13	+0.3	9
1.39	13	−0.2	9
1.77	1		
1.60	1	−1.6	1
1.73	4	+1.3	3
1.77	1	−5.6	1
1.83	4	−1.4	3
2.09	1	−3.9	1
1.81	13	−0.1	9
2.02	1	−3.8	1

1st half $12^h.09^m$ $p_{50} = +1.500^s$ wt = 29

2nd " 13.14 $= +1.809$ = 26

$+1.654$

1st half 12.09 $q_{50} = -0''.25$

2nd 13.14 $q_{50} = -0.85$

-0.55

$x - x_0$	For p.		$x - x_0$	For q	$(x-x_0)^2 w$
.13	16	16	2.3	5	5
12	14	14	0.2	0	0
33	109	109	2.0	4	4
03	1	13	0.8	0.6	5.4
26	68	884	0.3	0.1	0.9
12	14	14			
.05	2	2	1.0	1.0	1.0
.08	6	24	1.9	3.6	10.8
12	14	14	5.0	25.	25.
16	32	128	0.9	0.8	2.4
44	194	194	3.3	11	11.
16	26	338	0.4	0.2	1.8
37	137	137	3.3	11	11
	12	1887		$n-1 = 11$	78.3
		157			7.12

$0.674\sqrt{157} = 0.674 \times 0.40 = 0.270$

$0.674\sqrt{7.12} = 0.674 \times 2.7 = \pm 1''.8$

By Independent Reduction from Catalogue *1

Final Results Zone 49

$p = +1.282 \pm$ $\frac{0.168}{\sqrt{55}} = \pm 0^s.023$

$q = -2.47 \pm$ $\frac{2.25}{\sqrt{40}} = \pm 0''.35$

Zone 50

$p = +1.654 \pm$ $\frac{0.270}{\sqrt{55}} = \pm 0^s.036$

$q = -0''.55 \pm$ $\frac{0''.8}{\sqrt{40}} = \pm 0''.28$

The above are the independent values of p & q to be corrected

1st so that the results by both Zones shall be as nearly as possible alike

2nd so as to agree with adjacent zones.

See 2 pages on

* { By comparison with 4 good stars
† { twice observed in Zones 2 & 3

we have for $p_{49} = +1^s.30$ in 1st half wt: 19

$p_{50} = +1.67$ " 1st " =19

The mean by weights then gives

1st half $p_{49} = 1.253$ wt 45

2nd " 1.343 "

As the values of p from Zones 2 & 3 are in the very beginning of Zones 49 & 50 there seems no reason to suspect an alteration of the clock or instrument

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OBSERVATORY OF HARVARD COLLEGE.

REDUCTION OF ZONES.

ZONE 50 April 28th 1853 M 11h 52 Dec 0° 00′ 0″ 13.52 0.10 [Form, No. 1.]

H	229° 01′	$-6.35 = i$		H	229° 01′	$= i$	
α	180° 00′	cos. δ		α	210° 00′	cos. δ	
$H+\alpha$	49° 01′	c'	$= -6.35$	$H+\alpha$	79° 01′	c'	$= -6.35$
sin. $(H+\alpha)$	9.87789	cos. $(H+\alpha)$		sin. $(H+\alpha)$	9.99197	cos. $(H+\alpha)$	
sec. δ	0.00000	sin. δ	$-\infty$	sec. δ	0.00000	sin. δ	$-\infty$
$+19.43 = h$	1.28847	h		$= h$	1.28847	h	
b	1.16636 $= +14.67$	b'	$= 0.00$	b	1.28044 $= +19.07$	b'	$= 0.00$
G	241° 15′			G	241° 15′		
$G+\alpha$	61° 15′			$G+\alpha$	91° 15′		
sin. $(G+\alpha)$		cos. $(G+\alpha)$	9.68213	sin. $(G+\alpha)$		cos. $(G+\alpha)$	8.33875
tan. δ	$-\infty$			tan. δ	$-\infty$		
$+1.73 = g$		g	0.23804	$= g$		g	0.23805
a	$= 0.00$	a'	9.92018 $= +0.83$	a	$= 0.00$	a'	8.57680 $= -0.04$
	$f = -1.92$				$f = -1.92$		
		$d\delta$	$= -5.52$			$d\delta$	$= -6.39$
$d\alpha$ in seconds of arc	$= +12.75$			$d\alpha$ in seconds of arc	$= +17.15$		
	$-\frac{1}{3}$ 4.25	α	$= 12^h\ 00^m$		$-\frac{1}{3}$ 5.72	α	$= 14^h\ 00^m$
$d\alpha$ in seconds of time	$= +0.850^s$	δ	$= 0.00$	$d\alpha$ in seconds of time	$= +1.143^s$	δ	$= 0.00$

H	229° 01′	$= i$		H	° ′	$= i$	
α	195° 00′	cos. δ		α	″	cos. δ	
$H+\alpha$	64° 01′	c'	$= -6.35$	$H+\alpha$	″	c'	$=$
sin. $(H+\alpha)$	9.95372	cos. $(H+\alpha)$		sin. $(H+\alpha)$		cos. $(H+\alpha)$	
sec. δ	0.00000	sin. δ	$-\infty$	sec. δ		sin. δ	
$= h$	1.28847	h		$= h$		h	
b	1.24219 $= +17.47$	b'	$= 0.00$	b	$=$	b'	$=$
G	241° 15′			G	° ′		
$G+\alpha$	76° 15′			$G+\alpha$	″		
sin. $(G+\alpha)$		cos. $(G+\alpha)$	9.37600	sin. $(G+\alpha)$		cos. $(G+\alpha)$	
tan. δ	$-\infty$			tan. δ			
$= g$		g	0.23805	$= g$		g	0.23805
a	$= 0.00$	a'	9.61405 $= +0.41$	a	$=$	a'	$=$
	$f = -1.92$				$f =$		
		$d\delta$	$= -5.94$			$d\delta$	$=$
$d\alpha$ in seconds of arc	$= +15.55$			$d\alpha$ in seconds of arc	$=$		
	$-\frac{1}{3}$ 5.18	α	$= 13^h\ 00^m$		$-\frac{1}{3}$	α	$=$ ° ′ ″
$d\alpha$ in seconds of time	$= +1.037^s$	δ	$= 0.00$	$d\alpha$ in seconds of time	$=^s$	δ	$=$

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OBSERVATORY OF HARVARD COLLEGE.

REDUCTION OF ZONES.

ZONE 50 Rate of 22 +1.70 [Form, No. 2.]

$h = 1^h.00^m.2$

Sidereal Time = 10 h. 53 m.	Barometer = 30.134 in.	Att. Thermometer = 65. °	Ext. Thermometer = 53.4 °	+0.00 "
" = 13 " 12	" = 30.136	" = 63.	" = 49.3	+ .44
	+.002		−4.1	$d\tau'$ = +0.44

α h. m.	$d\alpha$ s.	dt s.	$d\alpha+dt$ s.	p δ	$k=p-d\alpha-dt$ δ
12 " 00	+0.850	+0.000	+0.850	+1.697	+0.847
13 " 00	+1.037	+0.070	+1.107	+1.697	+.590
14 " 00	+1.143	+0.141	+1.284	+1.697	+.413

α h. m.	$d\delta$ "	$d\tau'$ "	$d\delta+d\tau'$ "	q "	$d=q-d\delta-d\tau'$ "
12 " 00	−5.52	+0.00	−5.52	+0.40	+5.92
13 " 00	−5.94	+0.19	−5.75	0.40	+6.15
14 " 00	−6.39	+0.38	−6.01	+0.40	+6.41

θ = 51

$d\delta$ = +0.99 "

$d\tau$ = 0.31

$d\delta - d\tau$ = +0.68

$d\delta - d\delta_1$ = −0.02

−0.70

Change of k for +10′ in Dec. = − 0.001 s.

Change of d for +10′ in Dec. = − 0.70 "

δ = 0 ° 10 ′	δ = 0 ° 10 ′	δ = 0 ° 10 ′	δ = 0 ° 10 ′

α h. m.	k s.	k s.	d "	d "
11 " 50	+0.90	+0.90	+5.9	+5.2
12 " 00	.85	.	5.9	5.2
" 10	.80	.	6.0	5.3
" 20	.75	.	6.0	5.3
" 30	.71	.	6.0	5.3
" 40	.67	.	6.1	5.4
12 " 50	.63	.	6.1	5.4
13 " 00	.59	.	6.2	5.5
" 10	.55	.	6.2	5.5
" 20	.52	.	6.2	5.5
" 30	.48	.	6.3	5.6
" 40	.46	.	6.3	5.6
13 " 50	.43	.	6.4	5.7
14 " 00	+0.41	+0.41	+6.4	+5.7

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Comparison of Zone 49 & 50 for difference of Zero
N.B. The differences of the corrections to mean places in the two do not amount to $0^s.01$ & $0''.1$ so that the observed differences can be employed unaltered.

	dR $Z_{49} - Z_{50}$	dδ $Z_{49} - Z_{50}$
$12^h\ 47^m$	+.35	+2″
	40	4
	50	3
	30	4
	45	3
	55	3
	50	4
	60	3
	50	3
	45	3
	40	2
	60	3
	40	1
	45	3
	50	3
	695	44
	232	15
	463	2.9

The following stars are to be used for the relative Zero of Zone 2 & 3 α 49 − 50

	Zone 2		Zone 3	
Z_2	11.. 52.. 49.85	+0°.. 07′.. 50″.4	11.. 52.. 49.95	0.. 07.. 51.8
cor of K	− 04	+ 3.5	− .01	+ 4.1
	11.. 52.. 49.81	0.. 07 .. 53.9	11.. 52 49 94	0.. 07 55.9
Z_3	49.94	55.9		
	11.. 52.. 49.87	0.. 07.. 54.9		
proc	+ 3.07	− 20.0		
@ 1853.0	11.. 52.. 52.94	0.. 07 .. 34.9		
	11.. 53.. 21.30	5.. 28.6	11.. 53.. 21.39	5.. 28.3
	− 04	5 + 23 5	− 01	+ 4.1
	11.. 53.. 21.26	5.. 32.1	21.38	5.. 32.4
	21.38	32.4		
	21.32	5.. 32.3	11.. 53.. 57.94	8.. 36.7
	3.07	− 20.0	− 01	+ 4.1
1853.0	11.. 53 .. 24.39	+ 0.. 5.. 12.3	11.. 53 57.95	8.. 40.8
			3.07	− 20.0
2.4 − 25	Zone 3		11.. 54.. 01.02	8.. 20.8
	11.. 54.. 14.69	6.. 14.0		
	− 01	+ 4.1		
	11.. 54.. 14.68	6.. 18.1		
	3.07	− 20.0		
1853.0	11.. 54.. 17.75	0.. 5.. 58.1		

The early & later portions give nearly the same differences

Adopted $Z_{49} - Z_{50}$ = +0.s45 in R
+2″.6 in Dec.

$\frac{1}{2}(p_{49} + p_{50})$ =	1.468	$\frac{1}{2}(q_{49} + q_{50})$ =	− 1.51
$-\frac{1}{2}45$	.225		∓ 1.30
$+\frac{1}{2}45$	.225		∓ 1.30
Z_{49} p	= +1.243	q	= − 2.81
Z_{50}	+ 1.693		= − 0.31

Values as corrected for coincidence of Z_{49} & Z_{50}

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Zones 49 & 50

α_2 23	α	11h 52m 52.94	0° 07' 34.9
t_{49}		52.60	34.0
	$\alpha - t$	+ 0.34	δ-s + 3.9
		11h 53m 24.39	0° 05' 12.3
	t	23.80	5' 7.0
		+ .59	+ 5.3
		11 54 00.78	0° 8' 20.8
		00.45	8 17.0
		+ .57	+ 3.8
		11h 54 17.75	0° 5' 58.1
		17.40	5 52.0
		+ .35	+ 6.1

	$\alpha - t$	= +0.34	+ 3.9	
		.59	5.3	1.658
		.57	3.8	Corr 39
		.35	6.1	p_{50} +1.697
		1.85	19.1	
	$\alpha - t$	+0.46	+4.8	
11h 54m	$d\alpha + dt$	+0.84	δ=7' -7.8	
	Zone 49	p = +1.30	q = 0.0	

By Zone 2 & 3

½ ~~Corr to coin~~

Zone 49	By Cat Stars	p = +1.282	wt 55	q = -2.″6	wt 40	
"	" 2 & 3	+1.30 #	19	0.0 ±	15	
		p_{49} +1.286	74	-1.9	59	
		p_{50} 1.658	Corr to coin	3		
		Mean 1.472		-2.2		
		Corr to coin	225			
		p_{49} = 1.286				
		Corr to coin Zone 50	- 039			
Final value		p_{49} = +1.247 ± 0.023		= 74		
		q_{49} = -2.″2 ± 0.″3		= 59		

$\frac{20}{\sqrt{74}} = \frac{20}{8.6}$

Zone 50

	$\alpha - t$		δ-s
		+.74	+ 5.9
		89	7.3
		87	6.8
		81	8.1
		11	-28.1
11h 54m		+0.83	7' +7.02
		+ .84	-5 03
	p	+1.67	q = +1.99

Zone	50		wt
By Cat. Stars	p = + 1.654		55
Zones 2 & 3		1.670	19
		1.658	74
Cat	q = -0.″55		40
Zone		+1.99	15
	q	+0.″08	55
		3	

For Zone 2 & 3 Stars

$R\begin{cases} \varepsilon = \sqrt{0.03^2 + \frac{2}{4} 0.048^2} = \sqrt{0.045^2} \\ \varepsilon = \pm 0^s.045 \quad \text{wt} = \left(\frac{.200}{.045}\right)^2 = 19 \end{cases}$

Dec $\varepsilon = \sqrt{0.″62^2 + \frac{2}{4}}$

p_{49} = +1.247 ± 0.023 = 74

q_{49} = -2.″2 ± 0.″3 = 59

p_{50} = +1.697 ± 0.023

q_{50} = +0.″4 ± 0.″3

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OBSERVATORY OF HARVARD COLLEGE.

REDUCTION OF ZONES.

ZONE

[Form, No. 1.]

H	° ′ ″	i =	″ .
α	,,	cos. δ	.
$H+\alpha$	,,	c'	= ″ .
sin. $(H+\alpha)$	.	cos. $(H+\alpha)$	.
sec. δ	.	sin. δ	.
h =	″ .	h	.
b	. = .	b'	. = .
G	° ′ ,,		
$G+\alpha$	,,		
sin. $(G+\alpha)$	.	cos. $(G+\alpha)$	.
tan. δ	.		
g =	″ .	g	.
a	. = .	a'	. = .
f =	.		
		$d\,\delta$	= .
$d\,\alpha$ in seconds of arc =	.		
$-\frac{1}{3}$	.	α =	° ′ ,,
$d\,\alpha$ in seconds of time =	s. .	δ =	

H	° ′ ,,	i =	″ .
α	,,	cos. δ	.
$H+\alpha$	,,	c'	= ″ .
sin. $(H+\alpha)$	.	cos. $(H+\alpha)$	.
sec. δ	.	sin. δ	.
h =	″ .	h	.
b	. = .	b'	. = .
G	° ′ ,,		
$G+\alpha$	,,		
sin. $(G+\alpha)$	.	cos. $(G+\alpha)$	.
tan. δ	.		
g =	″ .	g	.
a	. = .	a'	. = .
f =	.		
		$d\,\delta$	= .
$d\,\alpha$ in seconds of arc =	.		
$-\frac{1}{3}$	.	α =	° ′ ,,
$d\,\alpha$ in seconds of time =	s. .	δ =	

H	° ′ ,,	i =	″ .
α	,,	cos. δ	.
$H+\alpha$	,,	c'	= ″ .
sin. $(H+\alpha)$	.	cos. $(H+\alpha)$	.
sec. δ	.	sin. δ	.
h =	″ .	h	.
b	. = .	b'	. = .
G	° ′ ,,		
$G+\alpha$	,,		
sin. $(G+\alpha)$	.	cos. $(G+\alpha)$	.
tan. δ	.		
g =	″ .	g	.
a	. = .	a'	. = .
f =	.		
		$d\,\delta$	= .
$d\,\alpha$ in seconds of arc =	.		
$-\frac{1}{3}$	.	α =	° ′ ,,
$d\,\alpha$ in seconds of time =	s. .	δ =	

H	° ′ ,,	i =	″ .
α	,,	cos. δ	.
$H+\alpha$	,,	c'	= ″ .
sin. $(H+\alpha)$	.	cos. $(H+\alpha)$	.
sec. δ	.	sin. δ	.
h =	″ .	h	.
b	. = .	b'	. = .
G	° ′ ,,		
$G+\alpha$	,,		
sin. $(G+\alpha)$	.	cos. $(G+\alpha)$	.
tan. δ	.		
g =	″ .	g	.
a	. = .	a'	. = .
f =	.		
		$d\,\delta$	= .
$d\,\alpha$ in seconds of arc =	.		
$-\frac{1}{3}$	.	α =	° ′ ,,
$d\,\alpha$ in seconds of time =	s. .	δ =	

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OBSERVATORY OF HARVARD COLLEGE.

REDUCTION OF ZONES.

ZONE [Form, No. 2.]

Sidereal Time = h. m. in. ° °
" = " Barometer = . Att. Thermometer = . Ext. Thermometer = .
" = " " = . " = . " = .

α	$d\alpha$	dt	$d\alpha+dt$	p	$k=p-d\alpha-dt$
h. m.	s.	s.	s.	"	"
"	.	.	.	.	.
"	.	.	.	.	.
"	.	.	.	.	.

α	$d\delta$	dr'	$d\delta+dr'$	q	$d=q-d\delta-dr'$
h. m.	"	"	"	"	"
"	.	.	.	.	.
"	.	.	.	.	.
"	.	.	.	.	.

Change of k for $+10'$ in Dec. = s. .

Change of d for $+10'$ in Dec. = " .

$\delta=$ ° ' "	$\delta=$ ° ' "	$\delta=$ ° ' "	$\delta=$ ° ' "

α	k	k	d	d
h. m.	s.	s.	"	"
"	.	.	.	.
"	.	.	.	.
"	.	.	.	.
"	.	.	.	.
"	.	.	.	.
"	.	.	.	.
"	.	.	.	.
"	.	.	.	.
"	.	.	.	.
"	.	.	.	.
"	.	.	.	.
"	.	.	.	.
"	.	.	.	.

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OBSERVATORY OF HARVARD COLLEGE.

REDUCTION OF ZONES.

ZONE [FORM, No. 1.]

H	° ′ ″	$=i$	.
α	,,	cos. δ	.
$H+\alpha$	,,	c'	= .
sin. $(H+\alpha)$	.	cos. $(H+\alpha)$	.
sec. δ	.	sin. δ	.
$=h$	.	h	.
b	. = .	b'	. = .
G	° ′ ,,		
$G+\alpha$	,,		
sin. $(G+\alpha)$	.	cos. $(G+\alpha)$	.
tan. δ	.		
$=g$	.	g	.
a	. = .	a'	. = .
$f=$	.		
		$d\delta$	= .
$d\alpha$ in seconds of arc =	.		
$-\frac{1}{3}$	.	$\alpha=$	° ′ ,,
$d\alpha$ in seconds of time =	s. .	$\delta=$	

H	° ′ ″	$=i$	.
α	,,	cos. δ	.
$H+\alpha$	,,	c'	= .
sin. $(H+\alpha)$	.	cos. $(H+\alpha)$	.
sec. δ	.	sin. δ	.
$=h$	.	h	.
b	. = .	b'	. = .
G	° ′ ,,		
$G+\alpha$	,,		
sin. $(G+\alpha)$	.	cos. $(G+\alpha)$	.
tan. δ	.		
$=g$	.	g	.
a	. = .	a'	. = .
$f=$	.		
		$d\delta$	= .
$d\alpha$ in seconds of arc =	.		
$-\frac{1}{3}$	.	$\alpha=$	° ′ ,,
$d\alpha$ in seconds of time =	s. .	$\delta=$	

H	° ′ ″	$=i$	.
α	,,	cos. δ	.
$H+\alpha$	,,	c'	= .
sin. $(H+\alpha)$	.	cos. $(H+\alpha)$	.
sec. δ	.	sin. δ	.
$=h$	.	h	.
b	. = .	b'	. = .
G	° ′ ,,		
$G+\alpha$	,,		
sin. $(G+\alpha)$	.	cos. $(G+\alpha)$	.
tan. δ	.		
$=g$	.	g	.
a	. = .	a'	. = .
$f=$	.		
		$d\delta$	= .
$d\alpha$ in seconds of arc =	.		
$-\frac{1}{3}$	.	$\alpha=$	° ′ ,,
$d\alpha$ in seconds of time =	s. .	$\delta=$	

H	° ′ ″	$=i$	.
α	,,	cos. δ	.
$H+\alpha$	,,	c'	= .
sin. $(H+\alpha)$	.	cos. $(H+\alpha)$	.
sec. δ	.	sin. δ	.
$=h$	.	h	.
b	. = .	b'	. = .
G	° ′ ,,		
$G+\alpha$	,,		
sin. $(G+\alpha)$	.	cos. $(G+\alpha)$	.
tan. δ	.		
$=g$	.	g	.
a	. = .	a'	. = .
$f=$	.		
		$d\delta$	= .
$d\alpha$ in seconds of arc =	.		
$-\frac{1}{3}$	.	$\alpha=$	° ′ ,,
$d\alpha$ in seconds of time =	s. .	$\delta=$	

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OBSERVATORY OF HARVARD COLLEGE.

REDUCTION OF ZONES.

ZONE [Form, No. 2.]

Sidereal Time = h. m. s. Barometer = in. Att. Thermometer = ° Ext. Thermometer = °

" = " " = . " = . " = .

α	$d\alpha$	dt	$d\alpha+dt$	p	$k=p-d\alpha-dt$
h. m.	s.	s.	s.	"	"
"	.	.	.	.	.
"	.	.	.	.	.
"	.	.	.	.	.

α	$d\delta$	dr'	$d\delta+dr'$	q	$d=q-d\delta-dr'$
h. m.	"	"	"	"	"
"	.	.	.	.	.
"	.	.	.	.	.
"	.	.	.	.	.

Change of k for $+10'$ in Dec. = s. .

Change of d for $+10'$ in Dec. = " .

	$\delta=$ ° ′ "	$\delta=$ ° ′ "	$\delta=$ ° ′ "	$\delta=$ ° ′ "
α	k	k	d	d
h. m.	s.	s.	"	"
"	.	.	.	.
"	.	.	.	.
"	.	.	.	.
"	.	.	.	.
"	.	.	.	.
"	.	.	.	.
"	.	.	.	.
"	.	.	.	.
"	.	.	.	.
"	.	.	.	.
"	.	.	.	.
"	.	.	.	.
"	.	.	.	.
"	.	.	.	.

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OBSERVATORY OF HARVARD COLLEGE.

REDUCTION OF ZONES.

ZONE [Form, No. 1.]

H	° ′ ″	i	″
α	″	cos. δ	″
$H+\alpha$	″	c'	″ =
sin. $(H+\alpha)$		cos. $(H+\alpha)$	
sec. δ	″	sin. δ	
h	″ =	h	″
b	=	b'	=
G	° ′ ″		
$G+\alpha$	″		
sin. $(G+\alpha)$		cos. $(G+\alpha)$	
tan. δ	″		
g	″ =	g	″
a	=	a'	=
f =			
		$d\delta$	=
$d\alpha$ in seconds of arc =			
$-\frac{1}{3}$		α =	° ′ ″
$d\alpha$ in seconds of time =	s.	δ =	

H	° ′ ″	i	″
α	″	cos. δ	″
$H+\alpha$	″	c'	″ =
sin. $(H+\alpha)$		cos. $(H+\alpha)$	
sec. δ	″	sin. δ	
h	″ =	h	″
b	=	b'	=
G	° ′ ″		
$G+\alpha$	″		
sin. $(G+\alpha)$		cos. $(G+\alpha)$	
tan. δ	″		
g	″ =	g	″
a	=	a'	=
f =			
		$d\delta$	=
$d\alpha$ in seconds of arc =			
$-\frac{1}{3}$		α =	° ′ ″
$d\alpha$ in seconds of time =	s.	δ =	

H	° ′ ″	i	″
α	″	cos. δ	″
$H+\alpha$	″	c'	″ =
sin. $(H+\alpha)$		cos. $(H+\alpha)$	
sec. δ	″	sin. δ	
h	″ =	h	″
b	=	b'	=
G	° ′ ″		
$G+\alpha$	″		
sin. $(G+\alpha)$		cos. $(G+\alpha)$	
tan. δ	″		
g	″ =	g	″
a	=	a'	=
f =			
		$d\delta$	=
$d\alpha$ in seconds of arc =			
$-\frac{1}{3}$		α =	° ′ ″
$d\alpha$ in seconds of time =	s.	δ =	

H	° ′ ″	i	″
α	″	cos. δ	″
$H+\alpha$	″	c'	″ =
sin. $(H+\alpha)$		cos. $(H+\alpha)$	
sec. δ	″	sin. δ	
h	″ =	h	″
b	=	b'	=
G	° ′ ″		
$G+\alpha$	″		
sin. $(G+\alpha)$		cos. $(G+\alpha)$	
tan δ	″		
g	″ =	g	″
a	=	a'	=
f =			
		$d\delta$	=
$d\alpha$ in seconds of arc =			
$-\frac{1}{3}$		α =	° ′ ″
$d\alpha$ in seconds of time =	s.	δ =	

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OBSERVATORY OF HARVARD COLLEGE.

REDUCTION OF ZONES.

ZONE [Form, No. 2.]

Sidereal Time = h. m. s. Barometer = in. Att. Thermometer = ° Ext. Thermometer = °

" = " " = . " = . " = .

α	$d\alpha$	dt	$d\alpha+dt$	p	$k=p-d\alpha-dt$
h. m.	s.	s.	s.	"	"
"	.	.	.	.	.
"	.	.	.	.	.
"	.	.	.	.	.

α	$d\delta$	dr'	$d\delta+dr'$	q	$d=q-d\delta-dr'$
h. m.	"	"	"	"	"
"	.	.	.	.	.
"	.	.	.	.	.
"	.	.	.	.	.

Change of k for $+10'$ in Dec. = s. .

Change of d for $+10'$ in Dec. = " .

	$\delta =$ ° ' "	$\delta =$ ° ' "	$\delta =$ ° ' "	$\delta =$ ° ' "
α	k	k	d	d
h. m.	s.	s.	"	"
"	.	.	.	.
"	.	.	.	.
"	.	.	.	.
"	.	.	.	.
"	.	.	.	.
"	.	.	.	.
"	.	.	.	.
"	.	.	.	.
"	.	.	.	.
"	.	.	.	.
"	.	.	.	.
"	.	.	.	.
"	.	.	.	.
"	.	.	.	.

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OBSERVATORY OF HARVARD COLLEGE.

REDUCTION OF ZONES.

ZONE [FORM, No. 1.]

H	° ′ ″	$=i$	″
α	,,	cos. δ	
$H+\alpha$	,,	c'	$=$ ″
sin. $(H+\alpha)$		cos. $(H+\alpha)$	
sec. δ		sin. δ	
$=h$	″	h	
b	$=$	b'	$=$
G	° ′ ,,		
$G+\alpha$	,,		
sin. $(G+\alpha)$		cos. $(G+\alpha)$	
tan. δ			
$=g$	″	g	
a	$=$	a'	$=$
$f=$			
		$d\delta$	$=$
$d\alpha$ in seconds of arc $=$			
$-\frac{1}{3}$		$\alpha=$	° ′ ,,
$d\alpha$ in seconds of time $=$	s.	$\delta=$	

H	° ′ ,,	$=i$	″
α	,,	cos. δ	
$H+\alpha$	,,	c'	$=$ ″
sin. $(H+\alpha)$		cos. $(H+\alpha)$	
sec. δ		sin. δ	
$=h$	″	h	
b	$=$	b'	$=$
G	° ′ ,,		
$G+\alpha$	,,		
sin. $(G+\alpha)$		cos. $(G+\alpha)$	
tan. δ			
$=g$	″	g	
a	$=$	a'	$=$
$f=$			
		$d\delta$	$=$
$d\alpha$ in seconds of arc $=$			
$-\frac{1}{3}$		$\alpha=$	° ′ ,,
$d\alpha$ in seconds of time $=$	s.	$\delta=$	

H	° ′ ,,	$=i$	″
α	,,	cos. δ	
$H+\alpha$	,,	c'	$=$ ″
sin. $(H+\alpha)$		cos. $(H+\alpha)$	
sec. δ		sin. δ	
$=h$	″	h	
b	$=$	b'	$=$
G	° ′ ,,		
$G+\alpha$	,,		
sin. $(G+\alpha)$		cos. $(G+\alpha)$	
tan. δ			
$=g$	″	g	
a	$=$	a'	$=$
$f=$			
		$d\delta$	$=$
$d\alpha$ in seconds of arc $=$			
$-\frac{1}{3}$		$\alpha=$	° ′ ,,
$d\alpha$ in seconds of time $=$	s.	$\delta=$	

H	° ′ ,,	$=i$	″
α	,,	cos. δ	
$H+\alpha$	,,	c'	$=$ ″
sin. $(H+\alpha)$		cos. $(H+\alpha)$	
sec. δ		sin. δ	
$=h$	″	h	
b	$=$	b'	$=$
G	° ′ ,,		
$G+\alpha$	,,		
sin. $(G+\alpha)$		cos. $(G+\alpha)$	
tan. δ			
$=g$	″	g	
a	$=$	a'	$=$
$f=$			
		$d\delta$	$=$
$d\alpha$ in seconds of arc $=$			
$-\frac{1}{3}$		$\alpha=$	° ′ ,,
$d\alpha$ in seconds of time $=$	s.	$\delta=$	

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OBSERVATORY OF HARVARD COLLEGE.

REDUCTION OF ZONES.

ZONE [Form, No. 2.]

Sidereal Time = h. m. s. Barometer = in. Att. Thermometer = ° Ext. Thermometer = °

" = " " = . " = . " = .

α	$d\alpha$	dt	$d\alpha+dt$	p	$k=p-d\alpha-dt$
h. m.	s.	s.	s.	"	"
"	.	.	.	.	.
"	.	.	.	.	.
"	.	.	.	.	.

α	$d\delta$	dr'	$d\delta+dr'$	q	$d=q-d\delta-dr'$
h. m.	"	"	"	"	"
"	.	.	.	.	.
"	.	.	.	.	.
"	.	.	.	.	.

Change of k for $+10'$ in Dec. = s. .

Change of d for $+10'$ in Dec. = " .

	δ = ° ' "	δ = ° ' "	δ = ° ' "	δ = ° ' "
α	k	k	d	d
h. m.	s.	s.	"	"
"	.	.	.	.
"	.	.	.	.
"	.	.	.	.
"	.	.	.	.
"	.	.	.	.
"	.	.	.	.
"	.	.	.	.
"	.	.	.	.
"	.	.	.	.
"	.	.	.	.
"	.	.	.	.
"	.	.	.	.
"	.	.	.	.
"	.	.	.	.

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OBSERVATORY OF HARVARD COLLEGE.

REDUCTION OF ZONES.

ZONE

[Form, No. 1.]

H	° ′	$\cdot = i$	″
α	″	cos. δ	
$H+\alpha$	″	c'	$=$ ″
sin. $(H+\alpha)$		cos. $(H+\alpha)$	
sec. δ		sin. δ	
$\cdot = h$	″	h	
b	$=$ ″	b'	$=$
G	° ′		
$G+\alpha$	″		
sin. $(G+\alpha)$		cos. $(G+\alpha)$	
tan. δ			
$\cdot = g$	″	g	
a	$=$	a'	$=$
$f =$			
		$d\delta$	$=$
$d\alpha$ in seconds of arc $=$			
$-\frac{1}{3}$		$\alpha =$	° ′ ″
$d\alpha$ in seconds of time $=$	s.	$\delta =$	

H	° ′	$\cdot = i$	″
α	″	cos. δ	
$H+\alpha$	″	c'	$=$ ″
sin. $(H+\alpha)$		cos. $(H+\alpha)$	
sec. δ		sin. δ	
$\cdot = h$	″	h	
b	$=$ ″	b'	$=$
G	° ′		
$G+\alpha$	″		
sin. $(G+\alpha)$		cos. $(G+\alpha)$	
tan. δ			
$\cdot = g$	″	g	
a	$=$	a'	$=$
$f =$			
		$d\delta$	$=$
$d\alpha$ in seconds of arc $=$			
$-\frac{1}{3}$		$\alpha =$	° ′ ″
$d\alpha$ in seconds of time $=$	s.	$\delta =$	

H	° ′	$\cdot = i$	″
α	″	cos. δ	
$H+\alpha$	″	c'	$=$ ″
sin. $(H+\alpha)$		cos. $(H+\alpha)$	
sec. δ		sin. δ	
$\cdot = h$	″	h	
b	$=$ ″	b'	$=$
G	° ′		
$G+\alpha$	″		
sin. $(G+\alpha)$		cos. $(G+\alpha)$	
tan. δ			
$\cdot = g$	″	g	
a	$=$	a'	$=$
$f =$			
		$d\delta$	$=$
$d\alpha$ in seconds of arc $=$			
$-\frac{1}{3}$		$\alpha =$	° ′ ″
$d\alpha$ in seconds of time $=$	s.	$\delta =$	

H	° ′	$\cdot = i$	″
α	″	cos. δ	
$H+\alpha$	″	c'	$=$ ″
sin. $(H+\alpha)$		cos. $(H+\alpha)$	
sec. δ		sin. δ	
$\cdot = h$	″	h	
b	$=$ ″	b'	$=$
G	° ′		
$G+\alpha$	″		
sin. $(G+\alpha)$		cos. $(G+\alpha)$	
tan. δ			
$\cdot = g$	″	g	
a	$=$	a'	$=$
$f =$			
		$d\delta$	$=$
$d\alpha$ in seconds of arc $=$			
$-\frac{1}{3}$		$\alpha =$	° ′ ″
$d\alpha$ in seconds of time $=$	s.	$\delta =$	

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OBSERVATORY OF HARVARD COLLEGE.

REDUCTION OF ZONES.

ZONE [Form, No. 2.]

Sidereal Time = h. m. Barometer = in. Att. Thermometer = ° Ext. Thermometer = °

" = " " = . " = . " = .

α	$d\alpha$	dt	$d\alpha+dt$	p	$k=p-d\alpha-dt$
h. m.	s.	s.	s.	"	"
"	.	.	.	.	.
"	.	.	.	.	.
"	.	.	.	.	.

α	$d\delta$	dr'	$d\delta+dr'$	q	$d=q-d\delta-dr'$
h. m.	"	"	"	"	"
"	.	.	.	.	.
"	.	.	.	.	.
"	.	.	.	.	.

Change of k for $+10'$ in Dec. = s. .

Change of d for $+10'$ in Dec. = " .

δ = ° ' " δ = ° ' " δ = ° ' " δ = ° ' "

α	k	k	d	d
h. m.	s.	s.	"	"
"	.	.	.	.
"	.	.	.	.
"	.	.	.	.
"	.	.	.	.
"	.	.	.	.
"	.	.	.	.
"	.	.	.	.
"	.	.	.	.
"	.	.	.	.
"	.	.	.	.
"	.	.	.	.
"	.	.	.	.
"	.	.	.	.

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OBSERVATORY OF HARVARD COLLEGE.

REDUCTION OF ZONES.

ZONE [Form, No. 1.]

H	° ′ ″	i =	.
α	,,	cos. δ	.
$H+\alpha$	,,	c'	= .
sin. $(H+\alpha)$	.	cos. $(H+\alpha)$	.
sec. δ	.	sin. δ	.
h	= .	h	.
b	. = .	b'	. = .
G	° ′ ″		
$G+\alpha$	,,		
sin. $(G+\alpha)$	.	cos. $(G+\alpha)$	.
tan. δ	.		
g	= .	g	.
a	. = .	a'	. = .
f =	.		
		$d\delta$	= .
$d\alpha$ in seconds of arc =	.	α =	° ′ ,,
$-\frac{1}{3}$	.		
$d\alpha$ in seconds of time =	s. .	δ =	

H	° ′ ″	i =	.
α	,,	cos. δ	.
$H+\alpha$	,,	c'	= .
sin. $(H+\alpha)$	.	cos. $(H+\alpha)$	.
sec. δ	.	sin. δ	.
h	= .	h	.
b	. = .	b'	. = .
G	° ′ ″		
$G+\alpha$	,,		
sin. $(G+\alpha)$	.	cos. $(G+\alpha)$	.
tan. δ	.		
g	= .	g	.
a	. = .	a'	. = .
f =	.		
		$d\delta$	= .
$d\alpha$ in seconds of arc =	.	α =	° ′ ,,
$-\frac{1}{3}$	.		
$d\alpha$ in seconds of time =	s. .	δ =	

H	° ′ ″	i =	.
α	,,	cos. δ	.
$H+\alpha$	,,	c'	= .
sin. $(H+\alpha)$	.	cos. $(H+\alpha)$	.
sec. δ	.	sin. δ	.
h	= .	h	.
b	. = .	b'	. = .
G	° ′ ″		
$G+\alpha$	,,		
sin. $(G+\alpha)$	.	cos. $(G+\alpha)$	.
tan. δ	.		
g	= .	g	.
a	. = .	a'	. = .
f =	.		
		$d\delta$	= .
$d\alpha$ in seconds of arc =	.	α =	° ′ ,,
$-\frac{1}{3}$	.		
$d\alpha$ in seconds of time =	s. .	δ =	

H	° ′ ″	i =	.
α	,,	cos. δ	.
$H+\alpha$	,,	c'	= .
sin. $(H+\alpha)$	.	cos. $(H+\alpha)$	.
sec. δ	.	sin. δ	.
h	= .	h	.
b	. = .	b'	. = .
G	° ′ ″		
$G+\alpha$	,,		
sin. $(G+\alpha)$	.	cos. $(G+\alpha)$	.
tan. δ	.		
g	= .	g	.
a	. = .	a'	. = .
f =	.		
		$d\delta$	= .
$d\alpha$ in seconds of arc =	.	α =	° ′ ,,
$-\frac{1}{3}$	.		
$d\alpha$ in seconds of time =	s. .	δ =	

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OBSERVATORY OF HARVARD COLLEGE.

REDUCTION OF ZONES.

ZONE [Form, No. 2.]

Sidereal Time = h. m. Barometer = in. Att. Thermometer = ° Ext. Thermometer = °

" = " " = . " = . " = .

α h. m.	$d\alpha$ s.	dt s.	$d\alpha+dt$ s.	p "	$k=p-d\alpha-dt$ "
"	.	.	.	.	.
"	.	.	.	.	.
"	.	.	.	.	.

α h. m.	$d\delta$ "	dr' "	$d\delta+dr'$ "	q "	$d=q-d\delta-dr'$ "
"	.	.	.	.	.
"	.	.	.	.	.
"	.	.	.	.	.

Change of k for $+10'$ in Dec. = s. .

Change of d for $+10'$ in Dec. = " .

	δ = ° ' "	δ = ° ' "	δ = ° ' "	δ = ° ' "
α h. m.	k s.	k s.	d "	d "
"	.	.	.	.
"	.	.	.	.
"	.	.	.	.
"	.	.	.	.
"	.	.	.	.
"	.	.	.	.
"	.	.	.	.
"	.	.	.	.
"	.	.	.	.
"	.	.	.	.
"	.	.	.	.
"	.	.	.	.
"	.	.	.	.

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OBSERVATORY OF HARVARD COLLEGE.

REDUCTION OF ZONES.

ZONE [Form, No. 1.]

H	° ′ ″	$\cdot = i$	″
α	,,	cos. δ	
$H+\alpha$	,,	c'	″ =
sin. $(H+\alpha)$		cos. $(H+\alpha)$	
sec. δ		sin. δ	
″ $\cdot = h$		h	
b	″ =	b'	=
G	° ′ ,,		
$G+\alpha$	,,		
sin. $(G+\alpha)$		cos. $(G+\alpha)$	
tan. δ			
″ $\cdot = g$		g	
a	=	a'	=
$f =$			
		$d\delta$	=
$d\alpha$ in seconds of arc =			
$-\frac{1}{3}$		$\alpha =$	° ′ ″
$d\alpha$ in seconds of time =	s.	$\delta =$	

H	° ′ ″	$\cdot = i$	″
α	,,	cos. δ	
$H+\alpha$	,,	c'	″ =
sin. $(H+\alpha)$		cos. $(H+\alpha)$	
sec. δ		sin. δ	
″ $\cdot = h$		h	
b	″ =	b'	=
G	° ′ ,,		
$G+\alpha$	,,		
sin. $(G+\alpha)$		cos. $(G+\alpha)$	
tan. δ			
″ $\cdot = g$		g	
a	=	a'	=
$f =$			
		$d\delta$	=
$d\alpha$ in seconds of arc =			
$-\frac{1}{3}$		$\alpha =$	° ′ ″
$d\alpha$ in seconds of time =	s.	$\delta =$	

H	° ′ ″	$\cdot = i$	″
α	,,	cos. δ	
$H+\alpha$	,,	c'	″ =
sin. $(H+\alpha)$		cos. $(H+\alpha)$	
sec. δ		sin. δ	
″ $\cdot = h$		h	
b	″ =	b'	=
G	° ′ ,,		
$G+\alpha$	,,		
sin. $(G+\alpha)$		cos. $(G+\alpha)$	
tan. δ			
″ $\cdot = g$		g	
a	=	a'	=
$f =$			
		$d\delta$	=
$d\alpha$ in seconds of arc =			
$-\frac{1}{3}$		$\alpha =$	° ′ ″
$d\alpha$ in seconds of time =	s.	$\delta =$	

H	° ′ ″	$\cdot = i$	″
α	,,	cos. δ	
$H+\alpha$	,,	c'	″ =
sin. $(H+\alpha)$		cos. $(H+\alpha)$	
sec. δ		sin. δ	
″ $\cdot = h$		h	
b	″ =	b'	=
G	° ′ ,,		
$G+\alpha$	,,		
sin. $(G+\alpha)$		cos. $(G+\alpha)$	
tan. δ			
″ $\cdot = g$		g	
a	=	a'	=
$f =$			
		$d\delta$	=
$d\alpha$ in seconds of arc =			
$-\frac{1}{3}$		$\alpha =$	° ′ ″
$d\alpha$ in seconds of time =	s.	$\delta =$	

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OBSERVATORY OF HARVARD COLLEGE.

REDUCTION OF ZONES.

ZONE [Form, No. 2.]

Sidereal Time = h. m. Barometer = in. Att. Thermometer = ° Ext. Thermometer = °

" = " " = . " = . " = .

α	$d\alpha$	dt	$d\alpha + dt$	p	$k = p - d\alpha - dt$
h. m.	s.	s.	s.	"	"
"	.	.	.	.	.
"	.	.	.	.	.
"	.	.	.	.	.

α	$d\delta$	dr'	$d\delta + dr'$	q	$d = q - d\delta - dr'$
h. m.	"	"	"	"	"
"	.	.	.	.	.
"	.	.	.	.	.
"	.	.	.	.	.

Change of k for $+10^t$ in Dec. = s. .

Change of d for $+10^t$ in Dec. = " .

δ = ° ' " δ = ° ' " δ = ° ' " δ = ° ' "

α	k	k	d	d
h. m.	s.	s.	"	"
"	.	.	.	.
"	.	.	.	.
"	.	.	.	.
"	.	.	.	.
"	.	.	.	.
"	.	.	.	.
"	.	.	.	.
"	.	.	.	.
"	.	.	.	.
"	.	.	.	.
"	.	.	.	.
"	.	.	.	.
"	.	.	.	.

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OBSERVATORY OF HARVARD COLLEGE.

REDUCTION OF ZONES.

ZONE

[Form, No. 1.]

H	° ′ ″	i =	″
α	″	cos. δ	
$H+\alpha$	″	c'	= ″
sin. $(H+\alpha)$		cos. $(H+\alpha)$	
sec. δ		sin. δ	
h =	″	h	
b	=	b'	=
G	° ′ ″		
$G+\alpha$	″		
sin. $(G+\alpha)$		cos. $(G+\alpha)$	
tan. δ			
g =		g	
a	=	a'	=
f =			
$d\alpha$ in seconds of arc =		$d\delta$	=
$-\frac{1}{3}$		α =	° ′ ″
$d\alpha$ in seconds of time =	s.	δ =	

H	° ′ ″	i =	″
α	″	cos. δ	
$H+\alpha$	″	c'	= ″
sin. $(H+\alpha)$		cos. $(H+\alpha)$	
sec. δ		sin. δ	
h =	″	h	
b	=	b'	=
G	° ′ ″		
$G+\alpha$	″		
sin. $(G+\alpha)$		cos. $(G+\alpha)$	
tan. δ			
g =		g	
a	=	a'	=
f =			
$d\alpha$ in seconds of arc =		$d\delta$	=
$-\frac{1}{3}$		α =	° ′ ″
$d\alpha$ in seconds of time =	s.	δ =	

H	° ′ ″	i =	″
α	″	cos. δ	
$H+\alpha$	″	c'	= ″
sin. $(H+\alpha)$		cos. $(H+\alpha)$	
sec. δ		sin. δ	
h =	″	h	
b	=	b'	=
G	° ′ ″		
$G+\alpha$	″		
sin. $(G+\alpha)$		cos. $(G+\alpha)$	
tan. δ			
g =		g	
a	=	a'	=
f =			
$d\alpha$ in seconds of arc =		$d\delta$	=
$-\frac{1}{3}$		α =	° ′ ″
$d\alpha$ in seconds of time =	s.	δ =	

H	° ′ ″	i =	″
α	″	cos. δ	
$H+\alpha$	″	c'	= ″
sin. $(H+\alpha)$		cos. $(H+\alpha)$	
sec. δ		sin. δ	
h =	″	h	
b	=	b'	=
G	° ′ ″		
$G+\alpha$	″		
sin. $(G+\alpha)$		cos. $(G+\alpha)$	
tan δ			
g =		g	
a	=	a'	=
f =			
$d\alpha$ in seconds of arc =		$d\delta$	=
$-\frac{1}{3}$		α =	° ′ ″
$d\alpha$ in seconds of time =	s.	δ =	

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OBSERVATORY OF HARVARD COLLEGE.

REDUCTION OF ZONES.

ZONE [Form, No. 2.]

Sidereal Time = h. m. Barometer = in. Att. Thermometer = ° Ext. Thermometer = °

" = " " = . " = . " = .

α	$d\alpha$	dt	$d\alpha+dt$	p	$k=p-d\alpha-dt$
h. m.	s.	s.	s.	"	"
"	.	.	.	.	.
"	.	.	.	.	.
"	.	.	.	.	.

α	$d\delta$	dr'	$d\delta+dr'$	q	$d=q-d\delta-dr'$
h. m.	"	"	"	"	"
"	.	.	.	.	.
"	.	.	.	.	.
"	.	.	.	.	.

Change of k for $+10'$ in Dec. = s. .

Change of d for $+10'$ in Dec. = " .

δ = ° ' " δ = ° ' " δ = ° ' " δ = ° ' "

α	k	k	d	d
h. m.	s.	s.	"	"
"	.	.	.	.
"	.	.	.	.
"	.	.	.	.
"	.	.	.	.
"	.	.	.	.
"	.	.	.	.
"	.	.	.	.
"	.	.	.	.
"	.	.	.	.
"	.	.	.	.
"	.	.	.	.
"	.	.	.	.
"	.	.	.	.
"	.	.	.	.

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OBSERVATORY OF HARVARD COLLEGE.

REDUCTION OF ZONES.

ZONE [FORM, No. 1.]

H	° ′ ″	i =	″
α	″	cos. δ	
$H+\alpha$	″	c'	= ″
sin. $(H+\alpha)$		cos. $(H+\alpha)$	
sec. δ		sin. δ	
h =	″	h	
b	= ″	b'	=
G	° ′ ″		
$G+\alpha$	″		
sin. $(G+\alpha)$		cos. $(G+\alpha)$	
tan. δ			
g =	″	g	
a	=	a'	=
f =			
		$d\delta$	=
$d\alpha$ in seconds of arc =			
$-\frac{1}{2}$		α =	° ′ ″
$d\alpha$ in seconds of time =	s.	δ =	

H	° ′ ″	i =	″
α	″	cos. δ	
$H+\alpha$	″	c'	= ″
sin. $(H+\alpha)$		cos. $(H+\alpha)$	
sec. δ		sin. δ	
h =	″	h	
b	= ″	b'	=
G	° ′ ″		
$G+\alpha$	″		
sin. $(G+\alpha)$		cos. $(G+\alpha)$	
tan. δ			
g =	″	g	
a	=	a'	=
f =			
		$d\delta$	=
$d\alpha$ in seconds of arc =			
$-\frac{1}{2}$		α =	° ′ ″
$d\alpha$ in seconds of time =	s.	δ =	

H	° ′ ″	i =	″
α	″	cos. δ	
$H+\alpha$	″	c'	= ″
sin. $(H+\alpha)$		cos. $(H+\alpha)$	
sec. δ		sin. δ	
h =	″	h	
b	= ″	b'	=
G	° ′ ″		
$G+\alpha$	″		
sin. $(G+\alpha)$		cos. $(G+\alpha)$	
tan. δ			
g =	″	g	
a	=	a'	=
f =			
		$d\delta$	=
$d\alpha$ in seconds of arc =			
$-\frac{1}{2}$		α =	° ′ ″
$d\alpha$ in seconds of time =	s.	δ =	

H	° ′ ″	i =	″
α	″	cos. δ	
$H+\alpha$	″	c'	= ″
sin. $(H+\alpha)$		cos. $(H+\alpha)$	
sec. δ		sin. δ	
h =	″	h	
b	= ″	b'	=
G	° ′ ″		
$G+\alpha$	″		
sin. $(G+\alpha)$		cos. $(G+\alpha)$	
tan. δ			
g =	″	g	
a	=	a'	=
f =			
		$d\delta$	=
$d\alpha$ in seconds of arc =			
$-\frac{1}{2}$		α =	° ′ ″
$d\alpha$ in seconds of time =	s.	δ =	

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OBSERVATORY OF HARVARD COLLEGE.

REDUCTION OF ZONES.

ZONE [Form, No. 2.]

Sidereal Time = h. m. / „ = „ Barometer = in. . / „ = . Att. Thermometer = ° . / “ = . Ext. Thermometer = ° . / “ = .

α h. m.	$d\alpha$ s.	dt s.	$d\alpha+dt$ s.	p ″	$k=p-d\alpha-dt$ ″
„	.	.	.	.	.
„	.	.	.	.	.
„	.	.	.	.	.

α h. m.	$d\delta$ ″	dr' ″	$d\delta+dr'$ ″	q ″	$d=q-d\delta-dr'$ ″
„	.	.	.	.	.
„	.	.	.	.	.
„	.	.	.	.	.

Change of k for $+10'$ in Dec. = s. . Change of d for $+10'$ in Dec. = ″ .

$\delta =$ ° ′ „ $\delta =$ ° ′ „ $\delta =$ ° ′ „ $\delta =$ ° ′ „

α h. m.	k s.	k s.	d ″	d ″
„	.	.	.	.
„	.	.	.	.
„	.	.	.	.
„	.	.	.	.
„	.	.	.	.
„	.	.	.	.
„	.	.	.	.
„	.	.	.	.
„	.	.	.	.
„	.	.	.	.
„	.	.	.	.
„	.	.	.	.
„	.	.	.	.

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OBSERVATORY OF HARVARD COLLEGE.

REDUCTION OF ZONES.

ZONE

[Form, No. 1.]

H	° ′ ″	$\ldots = i$	″
α	,,	cos. δ	
$H+\alpha$	,,	c'	= ″
sin. $(H+\alpha)$		cos. $(H+\alpha)$	
sec. δ		sin. δ	
$\ldots = h$	″	h	
b	=	b'	=
G	° ′ ″		
$G+\alpha$	,,		
sin. $(G+\alpha)$		cos. $(G+\alpha)$	
tan. δ			
$\ldots = g$	″	g	
a	=	a'	=
$f =$			
		$d\delta$	=
$d\alpha$ in seconds of arc =		$\alpha =$	° ′ ″
$-\frac{1}{3}$			
$d\alpha$ in seconds of time =	s.	$\delta =$	

H	° ′ ″	$\ldots = i$	″
α	,,	cos. δ	
$H+\alpha$	,,	c'	= ″
sin. $(H+\alpha)$		cos. $(H+\alpha)$	
sec. δ		sin. δ	
$\ldots = h$	″	h	
b	=	b'	=
G	° ′ ″		
$G+\alpha$	,,		
sin. $(G+\alpha)$		cos. $(G+\alpha)$	
tan. δ			
$\ldots = g$	″	g	
a	=	a'	=
$f =$			
		$d\delta$	=
$d\alpha$ in seconds of arc =		$\alpha =$	° ′ ″
$-\frac{1}{3}$			
$d\alpha$ in seconds of time =	s.	$\delta =$	

H	° ′ ″	$\ldots = i$	″
α	,,	cos. δ	
$H+\alpha$	,,	c'	= ″
sin. $(H+\alpha)$		cos. $(H+\alpha)$	
sec. δ		sin. δ	
$\ldots = h$	″	h	
b	=	b'	=
G	° ′ ″		
$G+\alpha$	,,		
sin. $(G+\alpha)$		cos. $(G+\alpha)$	
tan. δ			
$\ldots = g$	″	g	
a	=	a'	=
$f =$			
		$d\delta$	=
$d\alpha$ in seconds of arc =		$\alpha =$	° ′ ″
$-\frac{1}{3}$			
$d\alpha$ in seconds of time =	s.	$\delta =$	

H	° ′ ″	$\ldots = i$	″
α	,,	cos. δ	
$H+\alpha$	,,	c'	= ″
sin. $(H+\alpha)$		cos. $(H+\alpha)$	
sec. δ		sin. δ	
$\ldots = h$	″	h	
b	=	b'	=
G	° ′ ″		
$G+\alpha$	,,		
sin. $(G+\alpha)$		cos. $(G+\alpha)$	
tan. δ			
$\ldots = g$	″	g	
a	=	a'	=
$f =$			
		$d\delta$	=
$d\alpha$ in seconds of arc =		$\alpha =$	° ′ ″
$-\frac{1}{3}$			
$d\alpha$ in seconds of time =	s.	$\delta =$	

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OBSERVATORY OF HARVARD COLLEGE.

REDUCTION OF ZONES.

ZONE [Form, No. 2.]

Sidereal Time = h. m. Barometer = in. Att. Thermometer = ° Ext. Thermometer = °

" = " " = . " = . " = .

α	$d\alpha$	dt	$d\alpha + dt$	p	$k = p - d\alpha - dt$
h. m.	s.	s.	s.	"	"
"	.	.	.	.	.
"	.	.	.	.	.
"	.	.	.	.	.

α	$d\delta$	dr'	$d\delta + dr'$	q	$d = q - d\delta - dr'$
h. m.	"	"	"	"	"
"	.	.	.	.	.
"	.	.	.	.	.
"	.	.	.	.	.

Change of k for $+10'$ in Dec. = s. .

Change of d for $+10'$ in Dec. = " .

$\delta =$ ° ' " $\delta =$ ° ' " $\delta =$ ° ' " $\delta =$ ° ' "

α	k	k	d	d
h. m.	s.	s.	"	"
"	.	.	.	.
"	.	.	.	.
"	.	.	.	.
"	.	.	.	.
"	.	.	.	.
"	.	.	.	.
"	.	.	.	.
"	.	.	.	.
"	.	.	.	.
"	.	.	.	.
"	.	.	.	.
"	.	.	.	.
"	.	.	.	.

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OBSERVATORY OF HARVARD COLLEGE.

REDUCTION OF ZONES.

ZONE [Form, No. 1.]

H	° ′ ″	$\cdot = i$	″
α	″	cos. δ	″
$H+\alpha$	″	c'	″ =
sin. $(H+\alpha)$		cos. $(H+\alpha)$	
″ sec. δ		sin. δ	
$\cdot = h$	″	h	
b	″ =	b'	″ =
G	° ′ ″		
$G+\alpha$	″		
sin. $(G+\alpha)$		cos. $(G+\alpha)$	
″ tan. δ			
$\cdot = g$		g	
a	=	a'	=
$f =$			
		$d\delta$	=
$d\alpha$ in seconds of arc =			° ′
$-\frac{1}{3}$		$\alpha =$	″
$d\alpha$ in seconds of time =	s.	$\delta =$	

H	° ′ ″	$\cdot = i$	″
α	″	cos. δ	″
$H+\alpha$	″	c'	″ =
sin. $(H+\alpha)$		cos. $(H+\alpha)$	
″ sec. δ		sin. δ	
$\cdot = h$	″	h	
b	″ =	b'	″ =
G	° ′ ″		
$G+\alpha$	″		
sin. $(G+\alpha)$		cos. $(G+\alpha)$	
″ tan. δ			
$\cdot = g$		g	
a	=	a'	=
$f =$			
		$d\delta$	=
$d\alpha$ in seconds of arc =			° ′
$-\frac{1}{3}$		$\alpha =$	″
$d\alpha$ in seconds of time =	s.	$\delta =$	

H	° ′ ″	$\cdot = i$	″
α	″	cos. δ	″
$H+\alpha$	″	c'	″ =
sin. $(H+\alpha)$		cos. $(H+\alpha)$	
″ sec. δ		sin. δ	
$\cdot = h$	″	h	
b	″ =	b'	″ =
G	° ′ ″		
$G+\alpha$	″		
sin. $(G+\alpha)$		cos. $(G+\alpha)$	
″ tan. δ			
$\cdot = g$		g	
a	=	a'	=
$f =$			
		$d\delta$	=
$d\alpha$ in seconds of arc =			° ′
$-\frac{1}{3}$		$\alpha =$	″
$d\alpha$ in seconds of time =	s.	$\delta =$	

H	° ′ ″	$\cdot = i$	″
α	″	cos. δ	″
$H+\alpha$	″	c'	″ =
sin. $(H+\alpha)$		cos. $(H+\alpha)$	
″ sec. δ		sin. δ	
$\cdot = h$	″	h	
b	″ =	b'	″ =
G	° ′ ″		
$G+\alpha$	″		
sin. $(G+\alpha)$		cos. $(G+\alpha)$	
″ tan. δ			
$\cdot = g$		g	
a	=	a'	=
$f =$			
		$d\delta$	=
$d\alpha$ in seconds of arc =			° ′
$-\frac{1}{3}$		$\alpha =$	″
$d\alpha$ in seconds of time =	s.	$\delta =$	

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OBSERVATORY OF HARVARD COLLEGE.

REDUCTION OF ZONES.

ZONE [Form, No. 2.]

Sidereal Time = h. m. Barometer = in. Att. Thermometer = ° Ext. Thermometer = °

" = " " = . " = . " = .

α h. m.	$d\alpha$ s.	dt s.	$d\alpha + dt$ s.	p "	$k = p - d\alpha - dt$ "
"	.	.	.	.	.
"	.	.	.	.	.
"	.	.	.	.	.

α h. m.	$d\delta$ "	dr' "	$d\delta + dr'$ "	q "	$d = q - d\delta - dr'$ "
"	.	.	.	.	.
"	.	.	.	.	.
"	.	.	.	.	.

Change of k for $+10'$ in Dec. = s. .

Change of d for $+10'$ in Dec. = " .

	δ = ° ' "	δ = ° ' "	δ = ° ' "	δ = ° ' "
α h. m.	k s.	k s.	d "	d "
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REDUCTION OF ZONES.

ZONE [Form, No. 2.]

Sidereal Time = h. m. s. Barometer = in. Att. Thermometer = ° Ext. Thermometer = °

" = " " = . " = . " = .

α h. m.	$d\alpha$ s.	dt s.	$d\alpha + dt$ s.	p "	$k = p - d\alpha - dt$ "
"	.	.	.	.	.
"	.	.	.	.	.
"	.	.	.	.	.

α h. m.	$d\delta$ "	dr' "	$d\delta + dr'$ "	q "	$d = q - d\delta - dr'$ "
"	.	.	.	.	.
"	.	.	.	.	.
"	.	.	.	.	.

Change of k for $+10'$ in Dec. = s. .

Change of d for $+10'$ in Dec. = " .

α h. m.	k (δ = ° ' ") s.	k (δ = ° ' ") s.	d (δ = ° ' ") "	d (δ = ° ' ") "
"	.	.	.	.
"	.	.	.	.
"	.	.	.	.
"	.	.	.	.
"	.	.	.	.
"	.	.	.	.
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REDUCTION OF ZONES.

ZONE [Form, No. 2.]

Sidereal Time = h. m. s.
" = "
" = "

Barometer = in.
" = .
" = .

Att. Thermometer = °
" = .
" = .

Ext. Thermometer = °
" = .
" = .

α h. m.	$d\alpha$ s.	dt s.	$d\alpha + dt$ s.	p ″	$k = p - d\alpha - dt$ ″
"	.	.	.	.	.
"	.	.	.	.	.
"	.	.	.	.	.

α h. m.	$d\delta$ ″	dr' ″	$d\delta + dr'$ ″	q ″	$d = q - d\delta - dr'$ ″
"	.	.	.	.	.
"	.	.	.	.	.
"	.	.	.	.	.

Change of k for $+10'$ in Dec. = s. .

Change of d for $+10'$ in Dec. = ″ .

δ = ° ′ "	δ = ° ′ "	δ = ° ′ "	δ = ° ′ "
α h. m.	k s.	k s.	d ″	d ″
"	.	.	.	.
"	.	.	.	.
"	.	.	.	.
"	.	.	.	.
"	.	.	.	.
"	.	.	.	.
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REDUCTION OF ZONES.

ZONE [Form, No. 2.]

Sidereal Time = h. m. in. ° °
" = " Barometer = . Att. Thermometer = . Ext. Thermometer = .
" = " " = . " = . " = .

α	$d\alpha$	dt	$d\alpha+dt$	p	$k=p-d\alpha-dt$
h. m.	s.	s.	s.	"	"
"	.	.	.	.	.
"	.	.	.	.	.
"	.	.	.	.	.

α	$d\delta$	dr'	$d\delta+dr'$	q	$d=q-d\delta-dr'$
h. m.	"	"	"	"	"
"	.	.	.	.	.
"	.	.	.	.	.
"	.	.	.	.	.

Change of k for $+10'$ in Dec. = s. . Change of d for $+10'$ in Dec. = " .

δ = ° ' "	δ = ° ' "	δ = ° ' "	δ = ° ' "

α	k	k	d	d
h. m.	s.	s.	"	"
"	.	.	.	.
"	.	.	.	.
"	.	.	.	.
"	.	.	.	.
"	.	.	.	.
"	.	.	.	.
"	.	.	.	.
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"	.	.	.	.

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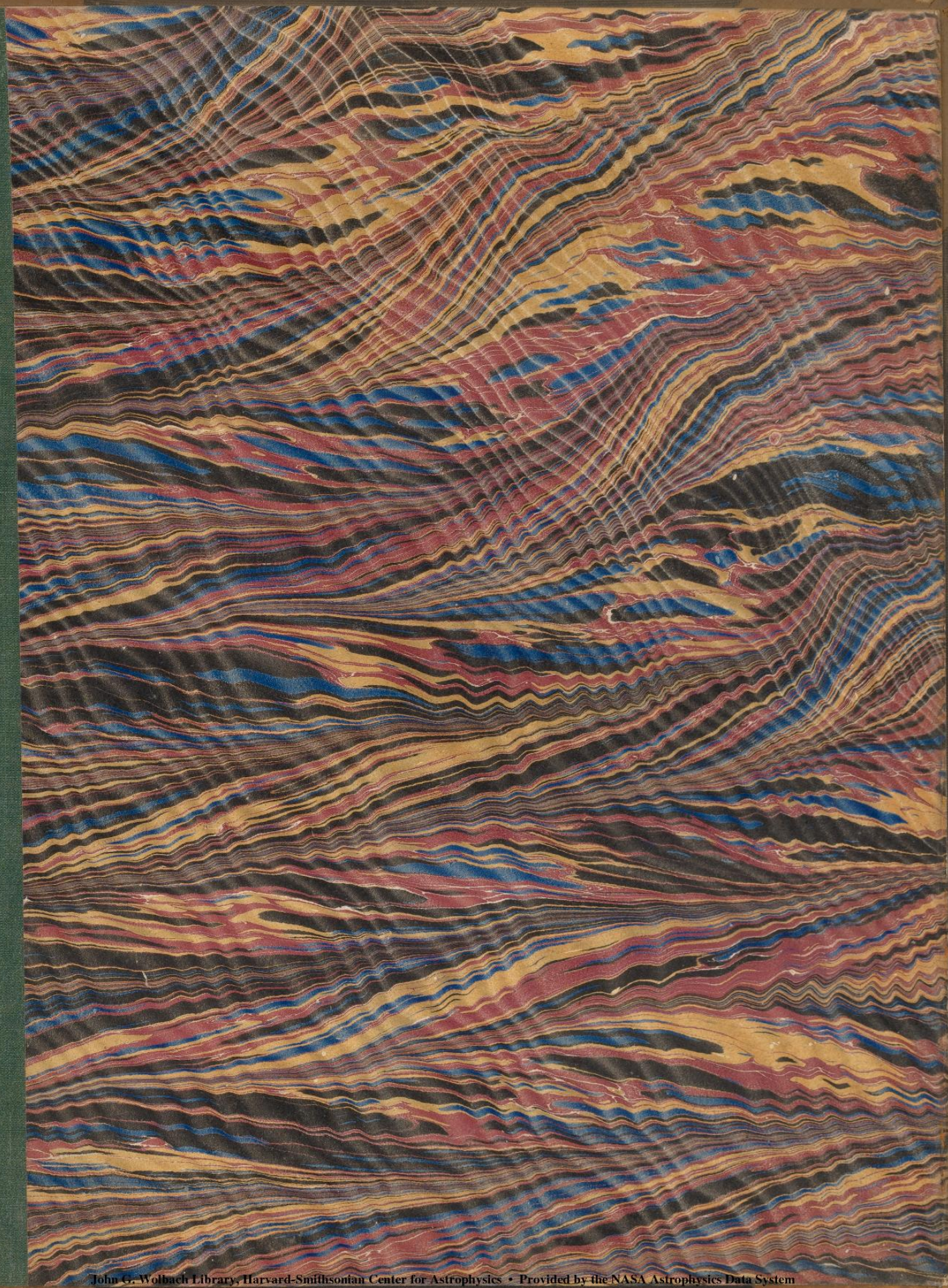
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